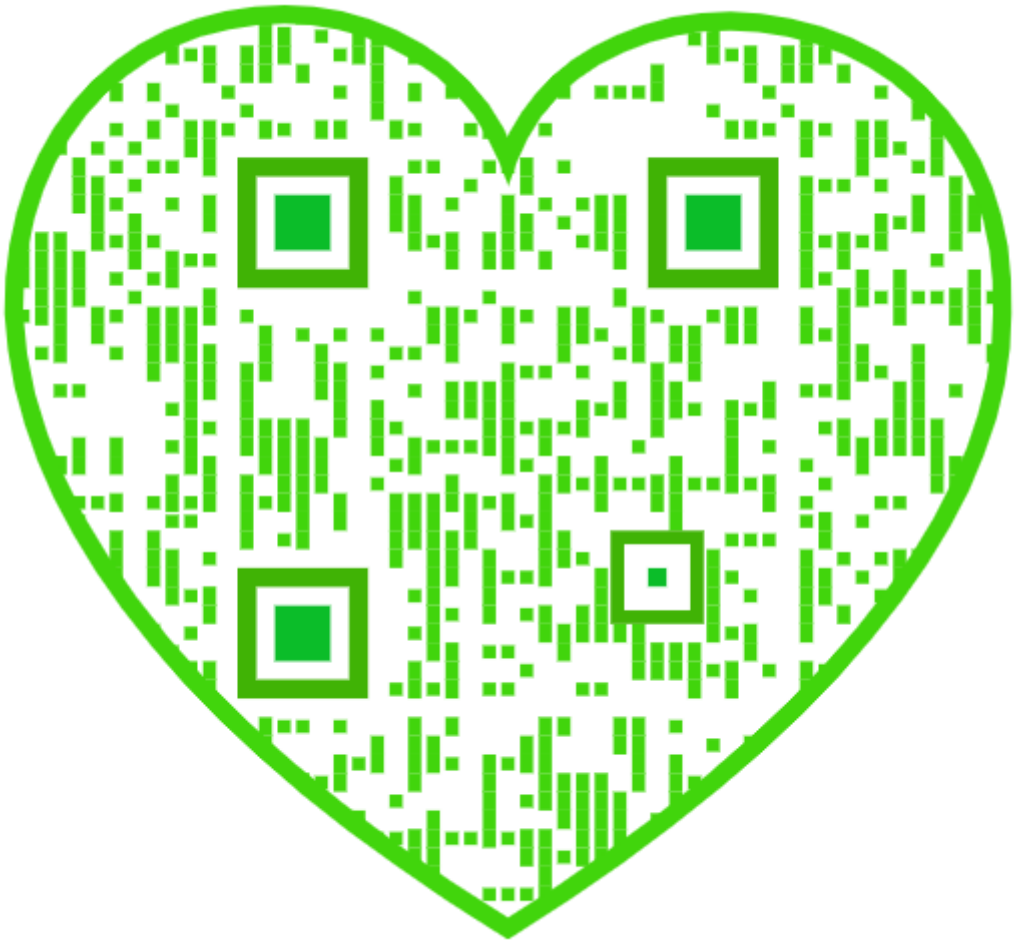

VETERINARY MATERIA MEDICA AND THERAPEUTICS

BY

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SEVENTH EDITION REVISED

NEW YORK
WILLIAM R. JENKINS COMPANY
PUBLISHERS
851 & 853 SIXTH AVENUE
(N.W. Cor. 48th St.)

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SEP 11 1916

PRINTED BY THE
PRESS OF WILLIAM R. JENKINS COMPANY
NEW YORK

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PREFACE TO SEVENTH EDITION

In the seventh edition every line has been scanned in the course of the revision and the book has been entirely re-set. Errors have been corrected, useless matter has been eliminated, and much new material has been inserted.

Recent additions to our knowledge of the physiological actions of ergot and digitalis have required the entire re-writing of the sections treating of the actions of these drugs while, for the same reason, the sections on the actions of adrenalin and quinine have been changed in part. The therapeutic matter throughout the whole book has been especially revised and amplified to keep abreast of therapeutic progress, including the entire section on Epitome of Modern Treatment.

We would call particular attention to the large additions which have been made to the therapeutic sections under Iodine, Bismuth, Magnesium Sulphate, Lysol, Phenol, Cocaine, Sodium Chloride, Arsenic, Camphor, Antiseptics, Practical Disinfection, Bacterial Filtrates and Vaccine Therapy.

Among medicinal agents included for the first time in this book are:—Glycerophosphates, Picric Acid, Sodium, Cacodylate, Choretone, Cresol, Aspirin, Novocaine, Thiosinamine, Fibrolysin, Yohimbine and Phenolphthalein.

A complete section on Poisons and Antidotes has been added for convenience in references.

Spinal Anesthesia has been considered in detail for the first time.

The matter on "Properties," "Description," and in many cases "Derivation" of drugs, is according to the U. S. Pharmacopœia, while the important preparations of both the U. S. and British Pharmacopœias are included.

KENELM WINSLOW.

PREFACE TO SIXTH EDITION

In this edition the chief change consists in the entire revision and almost complete rewriting of that part of the text treating of Physiological Action of Drugs. This is required by the many elaborate investigations of the newer school of pharmacologists, of which Prof. Arthur R. Cushny is the foremost English exponent.

Our conception of the action of many of the inorganic agents—of the salts especially—has undergone a radical transformation owing to the fact that we now know that the salts are usually for the most part dissociated into electric positive and negative elements (ions), in the weak solutions present in the tissues, and that they thus form chemical combinations to which their pharmacological action is due. The action of a salt, then, is commonly that of its ions, and not that of its molecules or atoms.

Among the revolutionary results of recent pharmacological experiments, to which we would call special attention in this revision, are those pertaining to the action of alcohol, ether and chloroform. Furthermore, readers will note the many additions to and changes in the physiological sections under iron, iodine, opium, caffeine, strychnine, pilocarpine, digitalis, veratrine, quinine and adrenalin. Also in the articles on Feeding and Counter-Irritants.

The wonderful experiments of Pawlow and others have upset the hitherto accepted teachings of the action of drugs on the digestive

organs and have wiped out the class of drugs known as cholagogues.

Finally, many therapeutic additions (see p. 752 *et seq.*) have been made in the constant endeavor of author and publisher to keep the book up to date.

KENELM WINSLOW.

August, 1908.

PREFACE TO FIFTH EDITION

In accordance with the hitherto expressed desire of the author and publisher to keep this work at its highest point of efficiency, it has seemed necessary to again present a new and revised edition—the fourth edition of 1906 being exhausted.

In the present revision the most notable feature is the substitution of a section on Condensed Treatment of Diseases of the Domestic Animals for the Index of Diseases and Remedial Measures, at the end of the book. In the preparation of this matter, very considerable time and pains have been taken to render this section a reflection and epitome of all that is most modern and progressive in veterinary therapeutics.

Special indications for treatment, including drugs and therapeutic agents other than drugs, in the different phases and stages of all the important diseases of the domestic animals, are to be found. These diseases embrace not only medical and surgical disorders, but those of the EYE, SKIN and EAR. If the attempt has been in any degree successful, this new edition to the book should prove one of its most valuable features both to practitioners and students.

Moreover, many changes have been made in the text in consonance with recent advances in our knowledge of the action of drugs.

KENELM WINSLOW.

PREFACE TO FOURTH EDITION

In the preparation of the fourth edition of this work, very considerable revision was made necessary on account of the many changes made in the eighth decennial revision of the United States Pharmacopœia of September, 1905.

To what an extent revision was required will be realized when it is known that there have been 123 additions, 106 changes in the strength of preparations, and 139 changes in the official title of drugs in the new Pharmacopœia.

Thus the doses of many preparations have suffered the most radical change; *e.g.,* the dose of tincture of aconite is three times what it formerly was, and that of the tincture of strophanthus is but half the former dose. Some of the most familiar of our old friends are scarcely recognizable by their new names, *e. g.,* Acetphenetidum (phenacetin), Arseni Trioxidum (acidum arsenosum), Phenol (acidum carbolicum), Spiritus Glycerylis Nitratis (Spiritus Glonoini), etc. All Extracta Fluida have been changed. Thus no longer we write Extracti Nucis Vomicæ Fluidi, but Fluidextracti Nucis Vomicæ. The official names of many salts are altered: hydrochlorate into hydrochloride; hydrobromate into hydrobromide; and valerianate into valerate; with corresponding changes in the Latin terminations. While some of the changes in the new Pharmacopœia do not affect veterinarians, yet professional prudence and pride demand that the veterinary practitioner conform to many of them to avoid mistakes in dosage and nomenclature.

In revising the General Index it was decided to make it a pronouncing vocabulary. That a professional knowledge of the proper pronunciation of drugs and terms of pharmacology is deplorably absent will be appreciated the moment attention is directed to the matter. So many teachers disregard the subject, it follows that every practitioner has a pronunciation of his own—each equally incorrect.

Notwithstanding the short time which has elapsed since the last edition of this book, a number of additions have been made to keep it abreast of the times. Since the work has become the recognized authority in Veterinary Materia Medica and Therapeutics, and is the standard text-book on the subject in the veterinary colleges of the United States, the author and publisher feel it their duty to constantly revise its pages in order to hold the book up to that standard which it has hitherto attained.

KENELM WINSLOW.

PREFACE TO FIRST EDITION

The writer wishes to acknowledge his indebtedness to the works of Brunton, Wood, Hare, Edes, Ringer, Bartholow, White and Mann, in human medicine; and to those of the following veterinary writers: Finlay Dun, Friedberger and Fröhner, Ellenberger, Koch, Cagny, Müller; and to the leading veterinary periodicals.

The matter on "properties," "description," and, in many cases, "derivation," is according to the U. S. Pharmacopœia, while the important preparations of both the U. S. and British Pharmacopœias are included. The classification and arrangement of drugs employed in this book are modifications of those adopted by W. Hale White in his excellent treatise on Materia Medica, Pharmacology and Therapeutics.

Kenelm Winslow.

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PRELIMINARY CONSIDERATIONS

Definitions

Pharmacology is derived from the Greek, *Pharmakos,* a drug, and is the sum of all exact knowledge pertaining to drugs, and therefore embraces Materia Medica, Therapeutics, and Pharmacy.

Materia Medica, derived from two Latin words signifying medical materials, treats of the derivation, natural history, physical and chemical properties, physiological actions, doses, and tests of purity of drugs. A special term sometimes used to describe the physical and chemical properties of drugs is *Pharmacognosy,* while *Pharmacodynamics* refers to the action of drugs on healthy animals.

Therapeutics, derived from the Greek, *Therapevo,* meaning to serve or attend the sick, is that branch of knowledge which treats of the application of all means—medicinal or otherwise—to the cure of disease or relief of pain. The term has been further subdivided as follows: *Rational Therapeutics,* which treats of the application of drugs as founded on their physiological actions; *Empirical Therapeutics;* the use of drugs as based on clinical evidence; and *General Therapeutics,* the use of remedial agents other than drugs, *e.g.,* Heat, Cold, Electricity, Food, etc.

Pharmacy is the art of preparing, compounding, dispensing and preserving drugs.

Toxicology, derived from the Greek *Toxikon,* a poison, is that branch of knowledge which treats of the nature, actions, detection and treatment of poisons.

A *medicine* is an agent of animal, vegetable or mineral origin used for the cure of disease or relief of pain. The word cure, signifies literally to care for, from the Latin *Curo,* and did not in its original sense mean to restore to health, although that is its present interpretation.

A *drug,* derived from the Dutch, *Droog,* meaning dry, is now used synonymously with medicine, although originally referring to an herb or dried medicinal plant.

MODE OF ACTION OF DRUGS.

Drugs act *locally* when they influence a part with which they come in contact, and also when they affect one organ or apparatus after absorption. The first meaning is the usual one.

Drugs act *generally* when they impress the body as a whole after absorption. Drugs applied to the unbroken skin usually act locally because they are commonly unabsorbed; also when drugs insoluble in the digestive tract (as charcoal and chalk), are given internally they act locally for the same reason. The local action of drugs after absorption is sometimes known as *selective action, i.e.,* the power that most drugs possess to influence one organ or apparatus rather than the whole system. Oftentimes this local action, in the case of secreting glands, is accomplished through stimulation of these parts during elimination of the drug. Occasionally a medicine acts both on the part with which it comes in contact and also through the circulation; *e.g.,* tartar emetic causes emesis by local stimulation of the stomach and by stimulation of the vomiting centre after absorption. Furthermore, remedies are said to exert a primary (or immediate) and secondary (or remote) action.

The secondary effect is the result of the primary action; *e.g.,* a saline cathartic primarily removes serous fluid from the bowels and secondarily or remotely leads to absorption of serous exudations; a counter-irritant primarily produces irritation of the skin and sensory nerve-endings, but secondarily relieves internal congestion by inducing reflex contraction of the subjacent blood vessels. Most drugs are absorbed into the blood after their ingestion and exert their action on various parts of the body through the medium of the nervous system. Some drugs, however, may directly influence muscular tissue, as is seen in the supposed action of digitalis on the nerve-free heart's apex; while others may immediately act on the cells of an organ, as pilocarpine on the sweat glands. As in the latter instance, it is usually impossible to determine whether medicines affect the cells of an organ or nerve-endings in the organ. The action of most vegetable drugs is thought to arise from the chemical affinity of their active principles for the part or parts acted upon.

Thus the selective action of strychnine depends upon its forming a chemical compound with the protoplasm of the cells of the spinal cord. The affinity of certain cells of the tissues and microorganisms for specific substances is shown in the staining of the nervous system alone by intravenous injection of methylene blue. It is, in fact, the basis of all bacteriological stains of Erlich's theory

of immunity and of his wonderful discovery of specifics for nagana, syphilis and relapsing fever.

All substances are divided into electrolytes and non-electrolytes.

Electrolytes are capable of decomposition into ions. The action of electrolytes, when used as medicines, is that of their ions. An ion is an electrified molecule or a molecule of a substance having a charge of positive or negative electricity.

In case the ions of inorganic salts are inactive their medicinal effect may be due wholly to what is technically termed "salt action." Salt action is dependent on osmosis. Any non-toxic salt (crystalloid) in the blood increases its concentration and leads to a flow of water into it from the surrounding tissues, increases its mass and thus acts as a diuretic. The action of most salts, acids, and bases depends on their being in great part dissociated in the weak solutions found in the tissues into electrically positive (kation) and negative (anion) ions. Nor does the action of an ion represent the chemical action of the atom, as when KCl is dissociated into a positive K ion and a negative Cl ion. The action of the ion is a physical or electrical action. Sometimes one ion is inert, as the Cl ion in KCl. Sometimes one is inert and the other very toxic, as KCN, where the positive or K ion is practically without action (see action of ions under special salts). In organic drugs the action of one ion is usually so powerful that the other may be neglected, as morphine sulphate.

No hypothesis can be formulated which will satisfactorily account for the curative action of all medicines in all diseases and systems of medicine, as allopathy and homeopathy, founded on such hypotheses, are valueless.

ABSORPTION OF DRUGS.

Drugs are absorbed most rapidly in solution (especially in alcohol) and when the circulation is active. Absorption from the digestive tract is poor when the circulation is depressed or in congested states; also from the subcutaneous tissues in similar conditions, more particularly in edema of these parts. Absorption from the stomach and bowels of healthy animals is chiefly influenced by the quantity of food in them. When these organs are empty, absorption is rapid; but when full, it is slow. For this reason absorption is markedly tardy and imperfect in ruminants. In these animals there is a comparatively impervious skin-like mucous membrane and lack of vascularity in the first three gastric compartments; while a large amount of food is always to be found in the first and third stomachs; all of which tends to delay absorption and lessen the action of medicines given by the mouth.

If drugs are irritating, they should be given to animals on the food, or after feeding, in order that they be sufficiently diluted.

ELIMINATION OF DRUGS.

A drug is as much outside the body when within the digestive tube—so far as any action it may have on the body (unless an irritant)—as if it were on the skin. When absorbed, a medicine passes into the blood vessels or lymphatics and thence into the general circulation. That portion which enters the portal circulation reaches the liver and may be destroyed in part (some alkaloids) by this organ. After entering the blood the drug may form unknown combinations with the tissues for which it has an affinity—thereby exerting its remedial effect—and is decomposed or rarely accumulates in the body, but usually is eliminated either unchanged or as decomposition-products in the breath, or by the excretions or secretions of the kidneys, bowels, liver, sudoriparous, salivary and mammary glands, and mucous membranes. The urine is the most frequent channel of elimination for soluble drugs. The bowels constitute the next more common pathway of elimination. Volatile drugs (chloroform, ether) are eliminated very rapidly, usually, in the breath. If a drug is eliminated slowly the duration of its action is correspondingly long, and vice versa. This fact will guide us in the frequency of administration of medicines, since if a drug which is tardily eliminated be given at frequent intervals it may be absorbed faster than it is excreted and so accumulate in the body and cause poisoning. The so-called *Cumulative Action* of a drug refers to the occurrence of a sudden and violent effect during its medicinal administration. This may be due (1) to delayed followed by rapid absorption; or (2) to slow—or sudden arrest of—elimination. The salts of the heavy metals, as lead, mercury, etc., and arsenical preparations are eliminated slowly. Digitalis and strychnine are said to be especially prone to produce a cumulative action. Strychnine may, however, be given subcutaneously in gradually increasing doses without the likelihood of poisoning. Digitalis may cause a cumulative effect in being slowly oxidized in the body or in leading to contraction of the renal vessels and suppression of urine-elimination. The drugs likely to cause a cumulative action must be administered infrequently, once, twice, or thrice daily; whereas medicines which are

rapidly decomposed and eliminated (alcohol, nitrites, etc.) may be given at very frequent intervals if desirable. The term excretion is often used synonymously with elimination, but, strictly speaking, a drug is not eliminated unless it has been first absorbed. On the other hand, an insoluble drug passing unabsorbed through the alimentary canal is said properly to be excreted in the feces.

CIRCUMSTANCES MODIFYING THE ACTION OF DRUGS.

Mode of Administration.

The following table gives the various methods of administering drugs in order of their rapidity of absorption, beginning with the method by which absorption is most rapid, and following with those by which absorption is less and finally least rapid:

1. Intravenous, by injection into the veins.
2. By inhalation (volatile drugs).
3. Subcutaneous, by injection into subcutaneous tissue.
4. Intratracheal, by injection into the trachea.
5. Oral, by the mouth.
6. Rectal, by the rectum.
7. Inunction, by the skin.
8. Intramammary injections.

1. Injection into the veins (usually into the jugular) is not so commonly practiced as the subcutaneous method, as there is a certain minute danger of inducing phlebitis, embolism and thrombosis. The danger is more theoretical than real, however, as we have frequently thrown from 5ʒ (150 cc.) to 6½ʒ (200 cc.) of fluidextract of cannabis indica into the jugular, and even chloral hydrate, a most irritating and caustic drug, in the dose of 1ʒ (30. c.c.) dissolved in 8ʒ (240 cc.) of water, without producing any untoward symptoms. No method of administration can secure more rapid absorption, since intravenous injection *is* absorption. This has constituted one of the theoretical objections to the method, that the sudden entrance of a drug might create shock. Injection into the jugular is useful when very rapid and effective action is imperative, as in causing immediate catharsis in colic and intestinal obstruction of horses. In such cases barium chloride and eserine sulphate are employed intravenously. The jugular is occluded with the hand and the injection is made with the same care described below in reference to the subcutaneous method. The intravenous use of hot normal salt

solution is frequently valuable in hemorrhage, shock and poisoning (see p. 655).

2. Volatile drugs are absorbed with great rapidity and effect owing to the enormous vascular surface of the lungs in contact with the inhaled vapor. Ether, chloroform, ammonia and amyl-nitrite are given by this method. Inhalation of medicated steam and sprays, used mainly for their local action on the respiratory tract, are also absorbed to some extent by the bronchial mucous membrane and lungs. This is a convenient and effective mode of applying local medication to horses in inflammatory troubles of the upper air passages, including the bronchial tubes, and in many cases may effect a cure without the use of internal remedies.

3. Subcutaneous or hypodermatic injection is suitable for soluble, non-irritating drugs of small bulk, when a sure and rapid action is desired. The medicinal solution should be free from solid particles and microörganisms. If the solution is not clean, or is irritating, abscess may occur. The syringe and needle must also be absolutely clean. Solutions made by dropping tablets in pure drinking water will rarely cause abscess, and the syringe may be made aseptic by filling it with alcohol (70 per cent.) and wiping the needle with the same, previous to their employment. Solutions may be preserved for hypodermatic use with boric acid (1 per cent.), but soluble tablets are more convenient.

In practising this method the hair should be removed from the seat of injection—preferably the thin skin underlaid by connective tissue behind the elbow or on the abdomen—and the part washed with water followed by alcohol; then a loose fold of skin is picked up and held firmly between the thumb and forefinger of the left hand, while the needle is thrust under the skin, but not into a vein. The syringe is slowly emptied and the needle withdrawn, keeping slight pressure over the point of injection with the thumb for a few seconds. The use of irritating drugs—permissible in emergencies—as fluidextract of ergot, tincture of digitalis, ether and ammonia, is less apt to be followed by abscess if injected deeply into the muscular substance, but this method causes more pain than ordinary injections. To avoid getting air in the veins, all the air is removed from the syringe before using, by holding it, needle upwards, and pushing in the plunger till a few drops of the solution are forced out of the needle. The danger of introducing air into the blood stream is greatly exaggerated, however, as the writer has proved by forcing vast quantities of air into the jugular vein of a horse without producing any untoward symptoms. The proper quantity of a solution for subcutaneous use is 5-30 minims for dogs; 1-2 drachms for horses, although large amounts of salt solution may be injected into the sub-

cutaneous tissue or muscles (hypodermoclysis) with great benefit in hemorrhage, etc. (See p. 657.)

The minimum doses of drugs should be employed by the subcutaneous method.

INDICATIONS FOR SUBCUTANEOUS INJECTION.

(*a*) To secure a rapid action, as in relieving intense pain or motor excitement; and to support a failing heart, respiration and vascular tone in severe operations, anesthesia, or other poisoning.

(*b*) When administration of drugs by the mouth is inadvisable or impossible, as in unconsciousness, dysphagia, convulsions or vomiting.

(*c*) When a local as well as general action is beneficial, *e.g.*, the use of strychnine in roaring and other local paralyses; atropine in local muscular spasms: veratrine in muscular rheumatism: intraneural injections of alcohol for neuralgia.

4. *Intratracheal injection* is a strictly veterinary procedure. The skin is incised aseptically with a sharp scalpel midway in the neck, and a stout needle (attached to a syringe) is thrust between the rings into the trachea. Larger quantities [H., ʒ i.-ii. (30.-60.)] and more irritating drugs are given in this way than by the subcutaneous method, and absorption is about as rapid; the dose is the same. There is undoubtedly danger, however, in giving irritant drugs by this method, especially chloral, and several cases of foreign-body pneumonia have come under our notice as the result of this mode of administration. It is the best method of benumbing or killing the parasites (S. *filaria* and *micrurus*) infesting the trachea and bronchi, and has been employed to influence the mucous membrane of the larynx and trachea in certain inflammatory conditions.

5. *Drugs are usually given by the mouth* and are absorbed from the stomach and intestines. Many non-irritating and not unpleasant drugs are taken voluntarily in the food, gruel, milk or drinking water by animals. Cats and dogs will often swallow medicine enclosed in a piece of meat. Absorption is more tardy than by the subcutaneous method, more rapid when given in solution into an empty stomach; slower when administered in powder, pill or ball, and on a full stomach. Some drugs are probably absorbed from the stomach, only to be destroyed or stored in the liver (alkaloids and heavy metals), and do not enter the general circulation at all.

When drugs are administered for their local action on the stomach, in catarrh or ulcer, they should be given an half hour to an

hour before feeding; if given for their action in or on the intestines, they should be administered two or three hours after meals.

6. *Rectal injections of medicines* (enemata or clysters) are practised when the use of drugs by the mouth is inadvisable or impossible, as in unconsciousness, dysphagia, convulsions; also to destroy parasites (oxyurides) in the rectum, to influence an inflamed or ulcerated rectal mucous membrane, and to remove intestinal contents (oil and glycerin).

The dose of drugs by this method is generally twice that by the mouth, and absorption is slower and more imperfect. The drug should be non-irritating, soluble, and not too bulky, since a small amount is necessary (℥i.-℥i. dogs; ℥ii.-℥viii. horses); to avoid tenesmus and expulsion. Warm starch solution (made by boiling) or linseed tea with a little laudanum is a good vehicle for medicinal enemata, and retention of enemata is facilitated by pressure on the anus with a towel for some minutes after the injection is given.

Solids are sometimes employed by rectum in suppositories. For general use of enemata see p. 26.

7. *Drugs are absorbed very slightly by the skin,* and then only when rubbed very vigorously into the epidermis (inunction) with lanolin, fat or oil of some kind. Mercury, silver and iodine are most commonly employed for absorption, but drugs are usually applied externally for their local action only and not to influence the general system through the blood.

Intramammary Injections.—These are useful in acute parenchymatous mastitis. The injection is done with a Davidson syringe connected with a sterile milking tube. From one quarter to one pint is injected slowly into each teat and allowed to remain fifteen minutes and slowly withdrawn. The treatment is given twice daily in contagious mastitis and but once in the simple form.

Saturated boric acid solution is most often used, or 1/10 to ½ per cent. solution of sodium fluoride.

Dosage.

The study of dosage is known as Posology. The action of drugs is altered both in degree and in kind by the dose. Thus, increasing the dose would naturally lead to an increase in the intensity of a drug's action, but it frequently changes the entire character of the action as well.

Drugs, as strychnine, acting especially on the nervous system, often excite in therapeutic doses, but depress and paralyze in toxic

doses. Drugs, as digitalis, stimulating the heart in medicinal doses, usually depress and paralyze the organ in poisonous doses. Many drugs promoting urinary secretion, in ordinary doses, cause inflammation and urinary depression in large doses. The best way to determine the dose of a drug is to estimate the amount required for each pound of live weight. This only applies to the same species and to animals of ordinary build. Fat is a comparatively inert tissue as far as the action of drugs is concerned, so that a very fat horse, weighing, for example, 1,200 pounds, would be affected in a more pronounced manner by a dose of medicine than would a lean horse of the same weight and taking the same dose. In the case of young animals, and of those either above or under the ordinary size of the adult of any species, the dose should be proportioned—according to weight—to the average dose for the adult animal of that species. Thus, if the average weight of a horse is 1,000 pounds, the dose of any drug for a colt weighing 500 pounds would be half the usual dose for adult horses. In a general way the dose for all animals from birth to a few weeks old, is one-twentieth of that suitable for the mature animal of the same species; for yearlings, about one-third of the adult dose. The dose recommended for dogs is commonly the same as that given to man, but this rule does not apply in the case of some powerful drugs (strychnine), where the dose should be adjusted to the weight, *i.e.*, so much per pound, live weight.

It is impossible to calculate the dose for all domestic animals as based on that for animals of one species, because the differences in anatomy and physiology modify the actions of drugs in degree and kind, but the dose for sheep is about one-fourth of that for the larger ruminants.

The repetition of a dose is determined to a considerable extent by the duration and rapidity of a drug's action. Agents used for their immediate effect, as those relieving pain and stimulating the circulation and respiration, are repeated frequently till the desired effect is attained. Medicines improving the condition of the digestion, blood and nutrition, as tonics of various kinds, require time for the accomplishment of their mission, and are usually given two or three times daily for a period of some weeks.

Anatomy and Physiology.

Certain differences in the action of medicines may be observed as occurring in the various species of animals, and in animals as contrasted in this respect with man.

ACTION OF DRUGS ON ANIMALS AS COMPARED WITH THAT ON MAN.

From a comparative standpoint the action of drugs on the nervous system of animals differs from that on man. This follows according to the "law of dissolution," which teaches that the more highly developed a part of the nervous system is in the evolutionary scale, the more sensitive is it to the influence of drugs. Since the cerebrum of man is relatively larger and more highly developed, in proportion to his weight, than is the case in animals, and since the spinal cord is larger and more highly developed in proportion to the brain in animals, it happens that drugs impressing the nervous system exert less effect on the brain, and more on the spinal cord, of animals than in man.

Thus opium is more powerful in its influence on the brain of man, and strychnine is more potent in its action on the spinal cord of animals. Drugs are not absorbed so rapidly or perfectly in the enormous digestive apparatus of ruminants as in man; neither do emetics act in these animals, nor in horses; while in none of the lower animals are agents causing sweating so efficient as in man.

ACTION OF DRUGS ON HORSES AS COMPARED WITH THAT ON OTHER ANIMALS.

Differences exist relative to the action of drugs on the horse, as compared with other animals, chiefly in respect to the digestive apparatus. Emetics do not act on the horse, as this animal does not vomit unless the stomach is greatly distended with gas, which causes dilatation of the cardiac outlet. Moreover, the stomach is too small to be successfully compressed by the abdominal walls, and the great length of the esophagus between the stomach and diaphragm, together with the horseshoe-like band of fibres at its cardiac extremity, prevent the regurgitation of food. The intestines of the horse, on the other hand, are as voluminous as the stomach is small, and therefore are powerfully influenced by irritants (as purgatives), although the action of cathartics is slow. The bowels of horses excrete vastly more of the fluid ingested than is the case in man or dogs—whose kidneys chiefly assume this function—and the kidneys are said to eliminate about 15 per cent. of the fluid ingesta in horses, as against 50 per cent. in man and dogs.

ACTION OF DRUGS ON RUMINANTS AS COMPARED WITH THAT ON OTHER ANIMALS.

The capacious four-fold stomach of ruminants always contains large amounts of food in the rumen and abomasum, while the impervious, poorly vascular and skin-like gastric mucous membrane renders absorption feeble and imperfect and enforces a comparatively larger dosage than is proper for horses of greater weight. Ruminants are also generally insusceptible to emetics. The skin and kidneys of ruminants are still less active than is the case in horses.

ACTION OF DRUGS ON DOGS AND PIGS AS COMPARED WITH THAT ON OTHER ANIMALS.

The action of medicine on dogs and pigs is similar in kind to that observed in man, but the former animals are less sensitive to drugs as a rule, since the dose suitable for a man weighing 150 pounds is appropriate for a dog of 40 pounds weight. As exceptions to this rule, we find that dogs will not bear the human dose of calomel, oil of turpentine, or strychnine. In fact, the ordinary tonic dose of strychnine (gr. 1/30) for man will throw a medium sized dog into convulsions, and may kill a small animal, notwithstanding that this amount is recommended as a suitable canine dose in veterinary text books.

Contrariwise, the dog is comparatively insensitive to many drugs powerfully influencing man,—notably morphine, aloes, colocynth and rhubarb. Most cathartics act more quickly on dogs than is the case with the other domestic animals, but saline purgatives are less appropriate in often causing vomiting, and because of their bulk.

Time of Administration.

This matter has been alluded to in speaking of the absorption of drugs. Medicines readily undergoing decomposition in the presence of other substances, as iodine and hydriodic acid, should be given on an empty stomach; and likewise all drugs, when a speedy action is desired. Irritants should be administered on a full stomach.

Habit.—This circumstance does not have the same importance in veterinary medicine which it possesses in human practice, since we control drug habits in animals. Animals usually become less susceptible to the action of drugs on their repetition, *e.g.,* opium and cathartics. This rule does not hold in the case of drugs having a cumulative action, nor in the repeated use of irritants on the skin, for then their action is strongly intensified.

Disease.—The action of drugs is profoundly influenced by disease. It is only possible to enumerate a few examples. Pain is almost an antidote to opium, and large repeated doses of the drug, previously innocuous, may, on the sudden cessation of pain, induce poisoning. Opium is also borne in enormous doses in peritonitis. Inflammation and congestion of the digestive organs hinders the absorption of all medicines. A congested condition of the alimentary canal, and even of the respiratory tract in horses, contra-indicate the use of strong purgatives in these animals, since superpurgation may occur. A high temperature alters the action of many drugs.

Opium is not so efficient as an analgesic in fevers, while antipyretics will not lower the temperature in health. Stimulants are not nearly so potent in depressed bodily conditions, and counter-irritants will not produce their characteristic actions on the skin when the circulatory functions are at a low ebb.

Idiosyncrasy.—Individual susceptibility to drugs is infrequent, but unfortunately cannot be anticipated. The writer has seen simple zinc oxide (free from adulteration or impurities) cause a frenzy of irritation when rubbed on a dog's skin, and a small dose of tartar emetic cause violent vomiting in a cow. Some animals are very susceptible to counter-irritants. Well-bred animals are commonly more responsive to drugs than others.

GENERAL ACTIONS OF DRUGS.

Drugs Acting on the Digestive Organs.

Sialagogues are agents increasing the secretion of saliva. *Antisialagogues* are agents diminishing salivary secretion. Among the sources of saliva—the parotid, sublingual and submaxillary glands—the latter have received most study. The chorda tympani, with its centre in the medulla, is one of the two nerves supplying the submaxillary gland. It contains two sets of fibres, the secretory and vasodilator. Hence stimulation of this nerve, or its centre, whether immediately or reflexly, leads, by means of its vasodilator fibres, to dilatation of the blood vessels and enhanced vascularity of the gland, and so indirectly to greater secretion; while, through excitation of the secretory fibres, the protoplasm of the glandular cells is influenced and secretion directly increased.

Reflexly the gland is stimulated by drugs exciting the peripheral terminations of the gustatory (lingual branch of the fifth nerve) and glossopharyngeal nerves in the mouth; the vagus endings in the stomach; by agencies sending pleasurable impressions to the brain through the medium of the eyes or nose; or by stimulation of other sensory nerves. The submaxillary gland is also supplied by a branch of the cervical sympathetic accompanying the submaxillary arteries. Stimulation of this nerve, or its centre, causes vascular constriction in the gland and inhibition of secretion.

Sialagogues are often classed under three heads. 1st, *Specific sialagogues,* acting directly on the mechanism concerned with secretion, *i.e.,* the gland cells, or nervous apparatus. Pilocarpine is the best example of the specific class. It stimulates the gland cell or peripheral nerve endings. 2nd, *Reflex sialagogues;* exciting sensory nerve terminations and indirectly or reflexly stimulating the nervous mechanism controlling secretion. As examples of this class may be mentioned alkalies, acids, emetics, and other agents stimulating the mucous membrane of the mouth and stomach. 3rd, *Mixed sialagogues,* acting both specifically and reflexly. Physo-

stigmine, nicotine or tobacco and mercury preparations may be included in this category.

Antisialagogues.—These drugs may act in various ways to lessen salivary secretion, but atropine is most notable in this regard. It acts by depressing the peripheral endings of the secretory nerves.

Uses.—Sialagogues are not of much therapeutic value. Some are added to the drinking water given to animals suffering from fever, to relieve dryness of the mouth and thirst. They are then called *refrigerants;* as, for example, potassium nitrate, diluted phosphoric and other acids. The sialagogues are sometimes employed to stimulate the mucous membrane of the pharynx in sore throat and relaxed conditions; as, for example, potassium chlorate in electuary for horses.

Excessive salivation produced by mercury salts or pilocarpine is relieved by an antisialagogue, *i. e.,* atropine.

Stomachics are drugs which, in therapeutic doses, mildly stimulate the mucous membrane of the mouth and stomach, thereby increasing the secretions and vascularity of these parts, the appetite, and, in a less degree, gastric peristalsis. These agents also influence the intestines, but this effect will be considered under carminatives.

Stomachics may be divided into bitters, aromatics (drugs containing a volatile oil and often very pungent), and aromatic bitters (drugs containing a volatile oil and a bitter principle). While both the bitters and aromatics enhance the appetite, the action of the latter is more powerful and fleeting. Very large doses of stomachics are distinctly irritating, and cause anorexia, nausea, and vomiting in animals capable of the act.

STOMACHICS.

BITTERS	AROMATICS	
Gentian	Coriander	
Calumba	Capsicum	
Quassia	Pepper	
Hydrastis	Ginger	Peppermint
Taraxacum	Cardamon	Alcohol
	Fennel	Ether
AROMATIC BITTERS	Fenugreek	Chloroform
Cascarilla	Anise	Alkalies (see Antacids)
Chamomile	Calamus	
Serpentaria	Mustard	
	Spearmint	

Uses.—Stomachics—particularly bitters—are serviceable in improving the appetite and gastric digestion in atonic indigestion,

and in enfeebled states of the digestive organs occurring in the course of chronic diseases or during convalescence from acute disorders. The aromatics are more frequently employed for their action on the intestines, when they are called carminatives. Bitters are contra-indicated in irritable or inflamed conditions of the alimentary tract.

Antacids are drugs which are used to counteract acidity in the stomach and bowels resulting from indigestion and fermentation, or from excessive secretion of gastric juice. Some (not ammonia compounds) are also occasionally employed to alkalize the blood and urine.

Pawlow's experiments, substantiated by many others, show that alkalies inhibit not only the secretion of acid gastric juice, but also all the other digestive secretions, *i.e.*, the secretions of the intestines, liver (bile), and pancreas (pancreatic juice). Antacids (as sodium bicarbonate and magnesia) are, however, indicated in gastric hypersecretion and hyperchlorhydria.

If administered several hours after eating, antacids counteract acidity due to fermentation and relieve pain caused by this condition. Since fermentation is frequently the cause of tympanites, the antacids are conjoined to advantage with carminatives (sodium bicarbonate and ginger). The alkaline carbonates allay pain by means of the carbonic dioxide set free in their decomposition in the digestive tract, and the antacids are also beneficial in dissolving an excessive secretion of mucus in catarrhal conditions of the alimentary canal.

The antacids are synonymous with alkalies, with the exception of the neutral vegetable salts—acetates, citrates and tartrates—of potassium and sodium, which are sometimes classed under this head. These do not alkalize the contents of the stomach, but nevertheless are broken up in the body and transformed into carbonates and thus render the urine more alkaline during their elimination. Among those included in the following list the sodium compounds are much less active in alkalizing the urine than the potassium salts. Sodium bicarbonate is in most frequent use in digestive disorders, but ammonium carbonate is particularly appropriate in flatulence, because it possesses more power in stimulating peristaltic action and expelling flatus.

ANTACIDS.

Sodium carbonate	Ammonium carbonate
Sodium bicarbonate	Magnesia
Potassium carbonate	Magnesium carbonate
Potassium bicarbonate	Calcium carbonate (chalk)

Solution of potash — Solution of lime (lime water)
Ammonia

Acids.—Contrary to accepted ideas, Pawlow's and Starling's experiments show that mineral acids directly stimulate the secretion of acid in the stomach, and, indirectly, the secretions of the intestines, liver and pancreas. The first part of gastric secretion is caused by vagal stimulation through reflex action produced by the desire, sight, and smell of food, and is further increased by the taking of food. In the latter part of gastric digestion, the acid product of the first part of digestion acts on the mucosa to cause the formation of a chemical body, or hormone (Greek, to excite), known as *gastrin.* This is absorbed into the blood and stimulates the activity of the secretory glands of the fundus of the stomach. In the intestines, acid chyme likewise leads to the formation of another hormone, *secretin,* which likewise is absorbed and stimulates the secretion of the intestines, liver and pancreas.

Carminatives include the same drugs which were mentioned as stomachics, namely, valerian, asafetida and the volatile oils; but the term as generally employed refers to their effect in exciting peristaltic action, and so expelling gas from the stomach and bowels. The aromatics are considerably more valuable for this purpose than the bitters. Carminatives also prevent griping caused by many cathartics, aid digestion, and disguise the taste of disagreeable drugs. Capsicum and ginger are most frequently prescribed in veterinary practice.

Digestives.—Pepsin is occasionally of benefit in the treatment of dogs and young animals in case of enfeebled gastric digestion resulting from acute diseases or other general causes. It should be administered directly after eating, and is prescribed to advantage with hydrochloric acid. As a general proposition it is inadvisable to give agents which merely substitute an artificial for the natural digestion, except as a temporary expedient. A wiser course consists in removing the cause of indigestion by proper feeding or by enforcing abstinence from food, and in the use of remedies calculated to strengthen the natural digestive functions.

Pancreatin may be given during, or immediately after, eating, and will assist gastric digestion for some time before sufficient acid is secreted to destroy it. In fact, some authors (Hare) insist that this substance is more valuable in any case than pepsin in aiding stomach digestion, although pancreatin is more commonly given several hours after eating, to promote intestinal digestion. Papain is another agent which is employed as an artificial digestive of vegetable origin. Its value is not yet definitely determined.

Antiseptics.—These agents are sometimes used to prevent or arrest fermentation of food in the stomach and bowels. Since fermentation is primarily due to indigestion, it is essential to remove the cause by diet and other rational means rather than to combat the effects of indigestion. Large doses of antiseptics hinder the digestive processes and may endanger the life of the patient, so that it is impossible to attain perfect antisepsis in the alimentary canal.

Among the drugs more commonly employed for their antiseptic action on the contents of the digestive tract may be mentioned:

Carbolic acid	Bismuth subcarbonate
Creosote	Bismuth salicylate
Creolin	Bismuth subgallate
Naphtol	Sodium sulphite. bisulphite
Naphtalin	and hyposulphite
Bismuth subnitrate	Hydrogen dioxide

Emetics are drugs which cause vomiting. The act of vomiting proceeds from irritation of the vomiting centre in the medulla, which is in close proximity to the respiratory centre. This centre is either acted upon directly by drugs circulating in the blood, or reflexly by agents stimulating sensory nerves in various parts of the body. Thus, irritation of the sensory nerve-endings of the mouth, throat, gullet, lungs, heart, stomach, bowels, biliary passages, peritoneum, uterus and kidneys, may produce vomition. Vomiting is occasioned by simultaneous contraction of the abdominal walls and the diaphragm. In this process the stomach is squeezed between the abdominal walls and diaphragm, and contraction of the longitudinal fibres, radiating from the lower end of the gullet, draws the stomach towards the diaphragm and so pulls open the cardiac orifice, while the pylorus is firmly contracted and closed. Some peculiarities may be noted in reference to vomition in the domestic animals. Dogs, pigs and cats vomit readily and may be placed in the same category as man in this respect. Horses rarely vomit and are not easily nauseated by emetics. Vomiting is prevented in these animals by: 1. The small size of the stomach, which is not readily compressed between the abdominal walls and diaphragm. 2. The length of the gullet between the stomach and diaphragm, which form a valve-like obstruction when the tube is shortened by contraction of the longitudinal fibres at its lower extremity in attempts at vomition. 3. A horseshoe-like band of fibres at the cardiac orifice, which hinders dilatation of this opening. Ruminants are likewise comparatively insusceptible to emetics because of the large size of their digestive apparatus, which is not easily compressed between the

parietes and diaphragm. Therefore the vomiting centre remains probably in a state of non-development in the horse and ruminant, by reason of non-use.

Cattle and horses do, however, occasionally vomit. Cattle at sea frequently suffer from *mal de mer,* and the writer has observed actual vomition in them following the use of tartar emetic. Horses may vomit when the stomach is greatly distended with gas.

Emetics may be classified as: 1. *Specific,* acting on the vomiting centre through the blood. 2. *Local,* by stimulation of the sensory nerve-endings in the mouth, throat, gullet and stomach. 3. *Mixed,* those acting in both ways.

It is impossible, in our present state of knowledge, to apply this classification accurately to individual drugs, but the following statements may be made: If an emetic is injected into the carotid and vomiting instantly occurs, the drug has probably acted upon the vomiting centre; if some time elapses before the occurrence of vomition, it is probable that the drug has acted upon the stomach during its elimination by that organ. Contrariwise, if, after the ingestion of an emetic, a considerable period intervenes before vomiting comes on, it is probable that the agent has acted on the vomiting centre.

Again, if a larger quantity of a drug is required when injected into the blood than when swallowed, to cause emesis, it is fair to suppose that the agent acts on the stomach directly or during its elimination. Finally, if an emetic is thrown into the blood after the removal of the stomach and substitution of a bladder in its place, and vomiting does not occur (Majendie's experiment with tartar emetic), it shows that the agent only acts on the stomach; but if vomiting does occur, it indicates that the agent acts on the vomiting centre and causes emesis by contraction of the parietes and diaphragm, with this reservation, that the drug may have been eliminated by the esophagus and intestines and have reflexly stimulated the vomiting centre through the medium of these parts. These remarks demonstrate the complexity of the subject.

EMETICS.

Specific	*Mixed*	*Local*
Apomorphine	Tartar Emetic	Tepid water
Senega	Ipecac	Mustard
Squills	Copper Sulphate	Salt
	Zinc Sulphate	Alum
		Ammonium Carbonate

Apomorphine is the only emetic given under the skin. It also acts well by the mouth, but causes more nausea an dallied effects than acting locally.

Mustard and salt, 1 teaspoonful each, in a cup of lukewarm water, form a convenient emetic for dogs. Ipecac is useful in respiratory diseases as an expectorant as well as emetic, and zinc sulphate is a prompt emetic in poisoning. The other emetics are practically unimportant.

Emetics cause, beside vomition, several other phenomena which are sometimes utilized therapeutically. Among these may be mentioned nausea, salivation, violent respiratory efforts, compression of the abdominal glands and ducts and extrusion of their contents, passive congestion of the head, chest, and peripheral parts by reason of compression of the abdominal veins. Increased secretion of the mucous membranes of the nose, eyes, stomach, gullet and bronchial tubes follow passive congestion. Muscular relaxation always accompanies nausea, and sweating ensues from relaxation of the skin and leaking out of the secretion. The flow of bile is increased on account of pressure on the liver and gall-bladder, while the secretion is also augmented.

The pulse and respiration are more frequent during emesis, but are diminished in force and frequency afterwards. All these phenomena are more apparent after the use of specific emetics.

Uses.—These apply particularly to dogs.

1. To empty the stomach in case of poisoning, over-loading of the organ, and indigestion with convulsions in young animals:—Mustard, salt or zinc sulphate.

2. To expel foreign bodies from the fauces and gullet (apomorphine subcutaneously); or, by the forcible expiration attending vomition, to expel excessive secretion or exudation from the air passages in laryngitis or bronchitis:—Ipecac.

3. To empty the gall-bladder in catarrhal jaundice and biliousness and to expel bile from the stomach.

4. To lower blood pressure and increase secretion in the first stage of bronchitis:—Ipecac.

5. To stop vomiting:—Ipecac in minute doses.

Contra-indications.—Pregnancy; hernia; inflammation of the stomach, brain or abdominal viscera; bleeding from the stomach, bowels or lungs; aneurism and asthenia.

Gastric sedatives and anti-emetics are agents used to relieve pain in the stomach and vomiting. These include:

Ice	Cocaine
Hot water	Cerium oxalate

Bismuth subcarbonate	Lime water
Bismuth subnitrate	Minute doses of arsenic
Carbon dioxide	" " " ipecac
Hydrocyanic acid	" " " alcohol
Morphine	" " " iodine
Menthol	" " " silver nitrate
Carbolic acid	Chloroform
Creosote	Chloral
Aconite	Bromides
Belladonna	Nitrites
Hyoscyamus	

Most of these agents act locally, but opium and morphine, chloral, the bromides, prussic acid and the nitrates act centrally.

USES OF GASTRIC SEDATIVES AND ANTI-EMETICS IN CANINE PRACTICE.

It must be recognized that vomiting is merely a symptom. It is, therefore, essential to remove the cause. This may sometimes be accomplished by starving, the use of an emetic, or tepid water. If vomiting is due to acute irritation of the stomach, as is frequently the case in dogs, ice and bismuth subnitrate (gr. x.-xx.), with tincture of aconite (♏ i.-ii.), form suitable remedies. When vomiting arises from indigestion and fermentation, carbolic acid with bismuth often acts favorably. The vomiting following anesthesia is probably of central origin. Here enemata of laudanum (♏ x.-xxx.) and sodium bromide (gr. xx.-xxx.) are beneficial. Ipecac, iodine, silver nitrate and the like are useful in vomiting dependent upon an atonic or depressed state of the stomach. When vomiting is continuous, small quantities of milk and lime water, equal parts, or peptonized milk (℥ ii.-iv.), or a drachm of cracked ice with a few drops of brandy, should be given at half-hour intervals. It may be rarely necessary to resort to rectal feeding.

Purgatives or cathartics are agents which empty the bowels. They act: (1) By stimulating peristaltic action. (2) By increasing the secretions (succus entericus) of the intestinal glands and, perhaps, transudation of fluid from the blood vessels in the walls of the intestines. (3) By hindering absorptions of secretions and fluids which normally occurs in the lower bowels. (4) By a combination of two or more of these methods. Purgatives may be divided into:

1. *Laxatives.*—These include such agents as:

Olive oil	Nux vomica
Cottonseed oil	Linseed oil } small dose
Magnesia	Castor oil } small dose
Sulphur	

These drugs slightly increase intestinal action, chiefly by stimulation of peristalsis.

2. *Simple Purgatives.*—These stimulate secretion and peristaltic action. Among them may be mentioned:

Aloes	Rhubarb
Calomel	Senna
Linseed oil	Cascara sagrada
Castor oil	Phenolphthalein
	Frangula

3. *Drastic Purgatives.*—Drastics are essentially gastro-intestinal irritants, and in large doses cause mucous and bloody diarrhea, congestion of the mucous membrane of the alimentary canal and severe colic. They may produce death in poisonous doses with collapse by reason of gastro-enteritis. Drastics greatly increase both peristaltic action and secretion, and are contra-indicated in irritable and inflamed conditions of the digestive tract. They are, however, indicated for their revulsant or derivative effect (*i.e.,* to dilate the blood vessels in the alimentary canal and to cause an outpouring of serum from the blood, thus relieving congestion in other parts) in some acute inflammations, as in brain diseases. Their medicinal action is often attended with considerable and irregular peristaltic contractions, so that griping occurs. The latter is prevented by suitable combination with other purgatives; with hyoscyamus and belladonna; or with carminatives, as ginger. The drastics include:

Croton oil	Scammony
Colocynth	Jalap
Gamboge	Elaterium

4. *Hydragogue Purgatives.*—Hydragogues are agents which chiefly increase the fluidity of the intestinal contents. They include:

(a) SALINE PURGATIVES

Magnesium sulphate	Sodium phosphate
Sodium sulphate.	Potassium bitartrate

(b) DRASTICS

Jalap	Scammony
Elaterium	

The salines stimulate secretion by reason of their bitterness, and by their irritant and specific properties. They, moreover, hold on to the fluid thus secreted and hinder its absorption because of

their slow diffusibility. Purgation follows, owing to the mechanical effect of the increased fluidity of the bowels, and since the augmented bulk of the intestinal contents excites peristaltic action. When it is desirable to remove fluid from the blood the salt should be given in concentrated solution, but when a speedy purgative action only is required the saline should be administered in considerable dilution. This happens because salines continue to cause an outpouring of fluid (succus entericus) into the intestines until a 5 to 6 per cent. solution of the salt is reached. The nearer to this degree of dilution (5-6 per cent.), therefore, the dose is given, the more quickly will it purge.

The drastics included in this class of purgatives have the power of markedly increasing intestinal secretion as well as peristaltic action.

5. *Cholagogue Purgatives.*—Cholagogues are agents which assist in removing bile from the body. They are supposed to do this in two ways: 1. By directly stimulating the secretion of bile. These are called *Direct Cholagogues,* or Hepatic Stimulants. 2. By increasing peristalsis in the upper portion of the small intestines, and thus hastening the expulsion of bile from the bowels. These are called *Indirect Cholagogues.* Some cholagogues are not generally considered purgatives, but it is proper to classify all of them thus, since bile stimulates peristalsis.

SUPPOSEDLY DIRECT CHOLAGOGUES.

*Sodium Salicylate
*Podophyllum
Aloes
Rhubarb
Colchicum
Sodium Sulphate
*Sodium Phosphate
Ipecac
Euonymus
*Nitro-hydrochloric Acid
Corrosive Sublimate

INDIRECT CHOLAGOGUES.

Calomel
Mercury
Most purgatives in a less degree.

The drugs marked with an asterisk have been found by clinical evidence most valuable.

The bile occurring at any time within the bowels is in part absorbed and then re-secreted. This process may be repeated indefinitely, but is prevented by purgatives, especially those increasing peristalsis in the duodenum and upper part of the jejunum

(calomel), because they hurry along and expel the bile in the gut before it has time to be absorbed.

In this way calomel and purgatives are indirect cholagogues in removing bile from the body; not by stimulating its secretion, but by hastening its excretion from the bowels. The experiments of Rutherford and Vignal have hitherto been chiefly responsible for the scientific basis of our belief in cholagogues. Their results have been swept aside by the more recent and thorough researches of Stadelmann, on animals, and of Pfaff, on men, with biliary fistulæ.

These researches show that there is no agent which has any marked influence in increasing the secretion of bile, except bile itself.

Salicylic acid and its compounds do, however, have a feeble cholagogue action. Moreover, there is no morbid condition in which increasing the flow of bile would prove remedial. We must regard the existence of cholagogue action then as exceedingly problematical at present.

Clinically so-called cholagogues are, nevertheless, of great value —as much so as they were ever thought to be. This happens, not because they increase the flow of bile, but because they act as purgatives (calomel), or as intestinal antiseptics (calomel, salicylic acid), expelling or inhibiting the formation of toxins or in some way improving digestion (nitrohydrochloric acid). The conditions in which they act most favorably are indigestion and constipation, with or without icterus and clay colored stools. Such conditions were formerly thought to be due primarily to disordered liver or "biliousness," but the cases amenable to treatment really arise in the beginning from functional disorder of the stomach or intestines. The clinical value of so-called cholagogues is therefore not at all disturbed—only the theory accounting for their action.

GENERAL USES OF PURGATIVES.

1. *To empty the bowels.*—In this way are removed fecal accumulations and poisonous matters resulting from bacterial infection, and from fermentative and putrefactive changes in the intestinal contents in indigestion. Foreign bodies, bile, pathological discharges and intestinal parasites are also expelled.

Peristaltic action is quickened in chronic constipation, while spasmodic and painful conditions (colic) are relieved by ridding the bowels of the source of irritation causing the trouble.

2. *To remove fluid from the body.*—This effect is more marked after the use of concentrated solutions of saline purgatives and other

hydragogues. Concentration of the blood and resulting absorption of dropsies of renal and cardiac origin, or inflammatory effusions, may be accomplished by these agents.

3. *To revulse.*—That is, to cause dilatation of the blood vessels in the intestinal walls and so withdraw blood from remotely congested areas, as in cerebritis. The drastics are appropriate for this service. Pain and nervous phenomena in other regions are sometimes benefited by the counter-irritant action of drastic cathartics.

4. *To deplete.*—Cathartics, particularly concentrated saline solutions, deplete the body both locally and generally by withdrawal of serum from the blood vessels. Purgatives tend to combat inflammation (antiphlogistic action) in this way by lowering blood tension while they also favor reduction of a febrile temperature by removal of toxins. Local depletion by salines is especially indicated in diarrhea and dysentery, and in the first stages of acute inflammation of the digestive tract. Plethora and obesity are often treated by a depletive method with cathartics.

5. *To eliminate.*—Deleterious material in the blood resulting from renal insufficiency, and probably from infection in acute diseases, may be eliminated to a considerable extent by purgatives. So also may the hemic sources of rheumatism, lymphangitis and hemoglobinemia be excreted.

Contra-indications.—These refer rather to the special agent than to any disorder, for there is scarcely a condition in which some cathartic is not permissible.

Drastics are inadmissible under the following circumstances: in catarrhal conditions of the respiratory and digestive tracts, intestinal hemorrhage, collapse, anemia, hernia, prolapse of rectum, metritis, nephritis, pregnancy, general debility, and in wounds of and operations upon the pelvic or abdominal viscera.

In well-defined enteritis and peritonitis cathartics are to be avoided. In mechanical obstruction of the intestines surgical interference is indicated when practicable, but where this is impossible enemata and some purgatives may be employed. The intestines, developed to an extent disproportionate to the size of the stomach in the horse, are powerfully influenced by cathartics, so that in catarrh of the respiratory organs and influenza, metastasis, or change in the site of the inflammation, may occur, and the intestines may become involved with the occurrence of excessive purging (superpurgation) after the ingestion of any but the mildest cathartics, as linseed oil. Aloes is the purgative given horses for ordinary purposes, while epsom and glauber salts are suitable for ruminants and pigs, and calomel and castor oil for dogs. Water assists the action of purgatives, and its ingestion should be encouraged by supplying

a liberal quantity of common salt either with the purgative or on the food, and also by sweetening the drinking water with molasses in the case of cattle. If the action of cathartics is delayed, it is usually advisable to give enemata.

Enemata, or Clysters.—These are fluid injections into the rectum and are used for the following purposes:

1. To empty the lower bowels when purgatives are inadmissible, as in intestinal obstruction, ulceration and inflammation, fecal accumulations, debilitated conditions, obstinate vomiting, unconsciousness, and in inability to swallow (sore throat and tetanus).

2. To relieve pain, spasm (of intestines and bladder), and shock, when deep, hot enemata (105°–115° F.) are used.

3. To save life. After severe hemorrhage, deep injections of hot normal salt solutions, 110 F.° (Enteroclysis, see p. 657.)

4. To accelerate the action of purgatives, and as a preparation for abdominal and pelvic operations.

5. To supply food. (See Artificial Feeding, p. 624.)

6. For their local effect upon inflammation of the mucous membrane of the rectum and colon. Opium and boiled starch solution; silver nitrate and tannic acid—in diarrhea, dysentery, colitis and proctitis.

7. To kill intestinal parasites (oxyurides),—solutions of quassia and common salt.

8. To administer medicines in dysphagia due to pharyngitis, tetanus, unconsciousness (apoplexy, coma and convulsions); to obstinate vomiting and other causes.

9. To reduce temperature,—cold enemata in fever.

10. To produce diuresis,—deep injections (110° F.) for retention and absorption into the blood.

11. To improve muscular tone and intestinal peristalsis in chronic constipation,—cold enemata (55°–60° F.).

12. To overcome twist and intussusception.

13. To stimulate peristalsis, relieve congestion, and increase the flow of bile in catarrhal jaundice,—cold, deep irrigations (55°–60° F.) are here indicated.

14. The stomach of dogs may be washed out by hanging them in an inverted position with the head down and allowing water (often several gallons) to flow into the rectum from a height of 6 feet until vomiting begins. The anus should be compressed by the fingers while giving the injection to prevent escape of the water. This treatment is valuable in food or chemical poisoning, or after ingestion of foreign bodies.

Enemata are best given by allowing water to gravitate into the bowel from a height of 2 to 4 feet. The ordinary fountain syringe

of human practice is suitable for the smaller animals, while for deep injections or irrigations a human rectal tube or soft catheter should be slipped over the hard rubber tube. In the case of horses or cattle, enemata may be siphoned through a rubber tube or piece of small hose. This is accomplished by filling the tube with water and compressing it at either end to prevent the escape of water, while one end is submerged in a pail or tub raised 2–4 feet above the patient, and the other end is then introduced directly within the bowel; or affixed to a rectal tube six feet long, when deep injections or irrigations are in order. A continuous flow is thus obtained. A still simpler method consists in pouring water into a funnel which has been fitted to one end of a rubber tube while the other end is passed into the rectum. That portion of the tube which is to be placed within the gut should always be lubricated with vaseline, oil or soap. Manual removal of hardened feces (scybala) must be practised in all animals before the use of enemata. The finger or blunt curette may be utilized for this purpose in small patients. The injection of linseed or cottonseed oil (H., Oi.; D., ℥ ii.) an hour before the use of larger enemata assists in softening the intestinal contents.

When deep injections are indicated, the hind quarters of the animal should be raised—small animals may be partially inverted —and the fluid allowed to flow in slowly, pushing in the rectal tube as the gut distends. Such enemata are more effective whether the object be to simply unload the bowels, to cause retention and absorption of the fluid, or to wash out the intestines. One to several gallons of warm water form a suitable quantity for unloading the bowels of large animals; one-half pint to a quart, in the case of small patients. The injections should be repeated until a good evacuation is secured. To increase the purgative effect of enemata a cup each of soft soap, salt and molasses are added to a gallon of water; or a tablespoonful of each to a pint. Equal parts of milk and molasses form one of the most efficient enemata known for causing catharsis (H., Ci.; D., Oi). Linseed oil or cottonseed oil are also mixed with water. Epsom salts are still more efficacious (H., lbii. to gallon of water; D., ℥ i.-iv. to pint); while oil of turpentine (H., ℥ ii.-iv.; D., ℥ i.-iv.) is very active and especially useful in colic and flatulence, mixed with the enema. When clysters are given to be absorbed they should always be very slowly injected by only raising the water supply from 4 to 7 inches above the anus. From 10 to 20 gallons of normal salt solution may be given to horses within 24 hours and several quarts to dogs—if an attendant can devote time to the purpose (p. 657). In chronic constipation and torpidity of the bowels plain cold water (55°–60° F.) injections are indicated.

Medicated irrigations are most serviceable in catarrhal disorders of the bowels (dysentery, etc.), *i.e.,* the fluid is allowed to flow in and out again till the solution returns clear.

Drugs Acting on the Circulation.

I.—Acting Upon the Blood.

(a) *Blood Plasma.*—The alkalinity of the blood plasma can be increased by the use of the salts of the alkaline and earth metals; *i.e.,* potassium, sodium, lithium, ammonium, magnesium and calcium compounds. This effect is of value therapeutically in rheumatism, hemoglobinemia and uric-acidemia. In the former two disorders, increasing the alkalinity of the blood plasma appears to assist in the elimination of toxic material, while in the latter condition the excretion of uric acid—existing in the blood as urates—is thought to be favored by potassium and lithium salts. These salts also alkalize the urine and increase its secretion. Drugs which remove considerable fluid from the body, as purgatives, diaphoretics and diuretics, necessarily alter the composition of the blood plasma. By removing fluid from the plasma, these agents are useful in aiding absorption of inflammatory exudations, dropsies and edemas, since the mass of fluid removed is soon replaced from that contained in the food and tissues. In the various infectious and constitutional diseases treatment is largely directed to exciting the secretions and excretions with the purpose of eliminating products of tissue waste and bacterial action from the blood, which prove detrimental to the system. This line of treatment is pursued in uremia, hemoglobinemia and lymphangitis. Venesection, saline infusions, hypodermoclysis and enteroclysis alter the character of the plasma and often have a life-saving value. (See p. 652.)

(b) *The red Corpuscles.*—The so-called blood tonics, or *hematinics,* influence the red corpuscles, increasing their number and content of hemoglobin when there is a deficiency of either. The effect upon the augmentation of hemoglobin is more marked.

HEMATINICS

Iron and its salts	Corrosive sublimate
Arsenic	Potassium permanganate
Copper salts	Manganese dioxide

The first two are immensely superior to the others in blood-making properties. Iron especially favors the formation of hemo-

globin; arsenic increases the number of red corpuscles. Certain agents possess toxicological significance by destroying the composition of hemoglobin. Large doses of the coal tar products, as acetanilid, antipyrin and phenacetin, nitrites and potassium chlorate, convert hemoglobin into methemoglobin, a mixture, probably, of hematin and soluble albumin; while carbonic oxide, phosphorus, sulphur, arsenic, iodine, hydrogen sulphide and turpentine, in large doses, reduce oxyhemoglobin and prevent its combination with oxygen. Acetanilid, potassium chlorate and amyl-nitrite destroy the red blood cells, if absorbed in considerable amount.

(c) *White Corpuscles.*—It is possible experimentally to arrest purulent exudations caused by irritation and inflammation when quinine is introduced into the blood or applied locally to blood vessels. This happens because quinine and all cinchona salts, berberine sulphate and acetanilid—like other poisons to amebae—prevent the ameboid movement or migration (diapedesis) of leucocytes through the vessel walls. Unfortunately it is impossible to give large enough doses in practice to realize such favorable results in inflammatory disorders. An enormous increase of leucocytes (leucocytosis) occurs in acute diseases accompanied by a local exudation process, and also in leukemia, etc. Nucleic acid may induce leucocytosis and may be valuable in bacterial infections. Its therapeutic value is still doubtful after many years of trial. Arsenic, and in some cases quinine, appear to reduce leucocytosis, and in leukemia seem to thus aid recovery. Drugs altering the consistency of the blood are: Calcium chloride and (to a less extent) other calcium salts, gelatin and potassium iodide, which increase the rate and degree of coagulation; cod-liver oil, which augments the solids in the blood; and toxic doses of mercury, which lessen the solids and coagulation and increase the fluidity of the blood.

II.—Drugs Acting on the Heart.

The following includes the mechanism controlling the heart, which may also be influenced by drugs:

1. The heart muscle. This contains the sinus node, which is a part of the heart muscle of the right auricle near the superior vena cava, and is called the pacemaker of the heart because the normal rhythmic impulses start here and spread to the auricles and thence through the small muscle called the auriculoventricular bundle, situated in the septum, and by its two branches to both ventricles. This impulse normally causes the auricles to contract and then, a moment later, the ventricles.

The heart muscle is itself capable of "rhythmically creating

a stimulus, of responding to a stimulus by contracting, of conveying the stimulus from muscle fibre to muscle fibre, and of maintaining its proper tone."

To bring the action of the heart into relation to the needs of the blood vessels a nervous mechanism is essential, as follows:

2. Inhibitory apparatus, including vagus roots in the medulla, vagus nerves with terminations in ganglia in the heart, and fibres passing from the ganglia to the sinus node and junctional tissue (between the auricles and ventricles) of the auriculoventricular bundle.

3. The accelerator apparatus consisting of the accelerator or sympathetic nerves with centres (presumably) in the brain, and in the inferior cornua of the anterior part of the spinal cord, with fibres connecting with the sympathetic thoracic ganglia whose cells send fibrils to the sinus node of the right auricle.

The essential object of the circulation, in the last analysis, is to produce an adequate flow in the capillaries. This depends upon the heart's output, the arterial resistance, and the amount and viscosity of the blood. The heart's output is the resultant of the filling, the capacity, the rate and the strength of the ventricles. Powerful stimulation of the vagus may arrest the heart in diastole, or may impede the passage of impulses through the auriculoventricular bundle (heart block), so that the ventricles beat more slowly than the auricles. Stimulation of the vagus may cause loss of tone so that there is more relaxation in diastole and less force in systole. The coronary arteries are filled from the aorta in both systole and diastole and prolonging diastole may or may not increase the amount of blood entering them. In general, moderate slowing of the heart increases its blood supply and nutrition. The heart is influenced by drugs as follows:

1. Stimulation of the inhibitory apparatus leads to slowing or weakening of the heart-beats, or to both.

2. Depression of the inhibitory apparatus results in quickening or strengthening the heart-beats, or both.

3. Stimulation of the accelerator apparatus causes an increase in the rate or force of the heart-beats, or both.

4. Depression of the accelerator apparatus induces decrease in the rate or force of the heart-beats, or both.

5. Stimulation of the heart-muscle produces increase in the rate or force of the heart-beats, or both.

6. Depression of the heart-muscle lowers the rate or force of the heart-beats, or both.

The vagus centre is stimulated by agencies increasing blood-pressure, or causing asphyxia. On the other hand, agencies reduc-

ing blood-pressure depress the vagus, or stimulate the accelerator nerve, or both. Thus, the nitrites, as amyl nitrite, nitro-glycerin and spirit of nitrous ether, quicken the heart by lowering vascular tension. External stimuli to sensory nerves reflexly stimulate the heart, as also do many locally irritating agents taken internally; *e.g.*, strong alcoholic or ammoniacal preparations.

Since drugs commonly influence more than one part of the mechanism controlling the heart, and since it is difficult to determine the exact physiological details in such complex actions, we shall content ourselves with tabulating the actions of drugs ordinarily employed for their influence on the heart, remembering that while moderate doses produce the effects enumerated below, poisonous doses often give rise to diametrically opposite actions.

(a) *Drugs increasing the force of the heart-beat.*

Digitalis
Adrenalin
Strophanthus
Sparteine
Squill
Physostigmine
} Slow the pulse

Barium salts
Camphor
} Do not alter rate particularly

(b) *Drugs increasing the rate of heart-beats.*

Belladonna
Atropine
Hyoscyamus
Stramonium
Cocaine

(c) *Drugs increasing the force and rate of heart-beats.*

Alcohol
Chloroform
Ether
Ammonia
Ammonium carbonate
Strychnine
Caffeine
Quinine
Arsenic

(d) *Drugs decreasing the force and rate of the heart-beats.*

Aconite
Veratrum viride
Antimony salts
Prussic acid
Ergot

NOTE.—Aconite and veratrum do *not* depress the heart in medicinal doses; they only slow it by cardio-inhibitory stimulation.

The drugs most frequently given to animals for their action on the heart are alcohol, ether, digitalis, strophanthus, ammonia, ammonium carbonate, camphor, caffeine, strychnine, atropine, aconite

and veratrum viride. The reader is referred to special articles on these drugs for therapeutical indications and other details.

III.—Drugs Acting on the Blood Vessels.

The following table includes the mechanism regulating vascular tension:

1. In the walls of the vessels.....	Smooth muscular fibres Terminations of vasodilators and vasoconstrictors
2. Nerve supply of vessels.....	Vasodilators Vasoconstrictors
3. Centres	Vasomotor centres in the medulla and subsidiary centres in the spinal cord and sympathetic system, controlling the vasodilating and constricting nerves

Each vessel is governed by two sets of fibres,—the constricting and dilating,—but we cannot discriminate between the action of a drug on the muscular fibres and the peripheral nerve endings in the vessel walls; nor can we always tell whether a drug acts to stimulate one set of peripheral fibres or depress the other.

Vascular tension is increased not only by contraction of vessels, but also by drugs which cause the heart to beat more quickly, and by those making its pulsations more forcible and complete, so that all the blood is squeezed out of the ventricle at each contraction. Contrariwise, blood pressure is diminished, not only by those drugs inducing vascular dilatation, but by those reducing the rate or force of the heart, or both.

We shall simply classify drugs influencing the vessels according as to whether they act after absorption into the blood, or only when applied locally to the vessel walls.

(a) *Drugs acting systemically to contract vessels.*

Adrenalin	Digitalis	Strychnine
Cocaine	Strophanthus	Hamamelis
Ergot	Squill	Hydrastis
Atropine	Sparteine	Physostigmine

(b) *Drugs acting systemically to dilate vessels.*

Amyl nitrite	Chloral
Nitroglycerin	Aconite
Spirit of nitrous ether	Opium
Alcohol	Belladonna (secondary action)
Ether	Hyoscyamus "
Chloroform	Stramonium "

(c) *Agents acting locally to contract vessels.*

Cold	Astringents

(d) *Agents acting locally to dilate vessels.*

Heat	Counter-irritants

Uses.—Drugs or agencies causing general dilatation of vessels are useful in overcoming internal congestions and colds by equalizing the circulation; that is, by causing the blood to be distributed more equably about the body. They are also of benefit in morbid conditions attended with a high, vascular tension; and are serviceable in dilating peripheral vessels and in causing perspiration and loss of heat in fevers (spirit of nitrous ether and alcohol). Drugs inducing general contraction of vessels are employed in disorders characterized by loss of tone, as in shock and collapse; and in heart weakness or disease (adrenalin, digitalis and strychnine); also in internal hemorrhage and inflammations (ergot); and to aid the absorption of dropsies and edemas. The uses of drugs locally contracting vessels will be described under Astringents (p. 57) and of agents locally dilating vessels under Counter-irritants (p. 56).

Drugs Acting on the Nervous System.

I.—Drugs Influencing the Brain.

It is impossible to classify drugs according to their action on the various centres of the brain, because our knowledge is insufficient. In a general way, drugs affecting the nervous system fall into two groups,—the excitant and depressant. But another difficulty arises in regard to classification from the fact that the same drug usually both excites and depresses. Many drugs influencing the nervous apparatus possess some exciting action, and most drugs

which excite in small doses cause depression and paralysis after poisonous quantities.

It is probable that alcohol, ether and chloroform are cerebral depressants from the very beginning, contrary to accepted ideas. Belladonna and its congeners, on the other hand, only excite the brain in large amounts; while opium and cannabis indica may excite the brain in small doses, but are used for their more common depressant action. The condition of the patient has some bearing on the action of a drug influencing the brain. Thus moderate doses of alcohol depress and stupefy healthy animals while stimulating the enfeebled and ill-nourished.

The brain of the lower animals is undeveloped compared to that of man, and, in accordance with the general fact that the more highly a portion of the nervous mechanism is organized the more powerfully is it influenced by drugs, it follows that drugs acting on the brain and cord are more prone to affect the cord in veterinary patients while impressing the brain more potently in man. For this reason we notice in the horse that the primary period of excitability (sometimes seen in man) following the administration of morphine is much prolonged and not infrequently completely obliterates the somnifacient action of the drug in this animal.

We shall be content to classify drugs acting on the nervous system according to their most pronounced action in moderate doses.

(a) *Cerebral Excitants.*

Camphor	Quinine
Caffeine	Cocaine

Uses.—These drugs are rarely used simply to excite the brain, but for other purposes. Camphor, caffeine and quinine are employed to generally excite the nervous system in depressed condition. Camphor is perhaps the best agent we possess to stimulate the heart and vital nerve centres in emergencies. Caffeine is a valuable antidote to the depressing cerebral action of opium in poisoning and is a potent heart stimulant.

(b) *Cerebral Depressants.*—It is fortunate that drugs progressively paralyzing the functions of the brain follow the so-called law of dissolution—*i.e.*, paralyze the various functions of the brain in the inverse order of their evolutionary development. The centres last to be acquired are the first to be paralyzed (cerebral centres); while those of earliest origin (the respiratory, vagus and vasomotor centres) are last to succumb to the action of cerebral depressants.

The cerebral depressants are used mostly to relieve pain, when they are called anodynes or analgesics. Pain is due to irritation of any sensory nerve, or the sensory tract in the spinal cord, or of the sensory centres in the brain. Pain may be relieved by paralyzing any portion of this path and destroying connection with the perceptive centres in the brain.

(1) *Anodynes, by reason of their action on the brain.*

Codeine	Alcohol	Cannabis Indica
Morphine	Anesthetics	Gelsemium
Opium	Chloral	Bromides

(2) *Narcotics.*—This term is a broad and somewhat inclusive one. Narcotics embrace drugs which depress the brain and cause sleep (hypnotics or soporifics) and stupor (some anodynes and anesthetics), and finally paralyze the respiratory and circulatory functions. The following may be included in this group:

Opium	Anesthetics	Cannabis Indica	Stramonium
Alcohol	Chloral	Belladonna	Hyoscyamus

(a) *Hypnotics or Soporifics* (drugs causing sleep):

Opium	Bromides	Paraldehyde	Sulphonal
Morphine	Cannabis Indica	Urethrane	Trional
Chloral		(Of little importance in veterinary practice)	

Uses.—Hypnotics are not of much value in Veterinary medicine by simply promoting sleep. Their general sedative and anodyne actions are utilized in relieving motor excitement (spasms) or sensory excitement (pain).

(b) *General Anesthetics.*

Ether	Nitrous oxide	Methylene bichloride
Chloroform	Ethylene dichloride	Schleich's mixture
	(Of slight value in veterinary medicine)	

Anesthetics are agents which abolish sensation generally or

locally. It is thought that the general anesthetics act directly on the nerve cells. Anesthetics—like narcotics generally—first stimulate and then depress the nerve centres, but depression is by far their most salient and useful effect.

Anesthetics destroy the functions of nerve centres in the cerebrum and spinal cord, and so abolish pain, sensation and reflex action. The law of dissolution is exemplified in their action. Anesthesia is commonly described in three stages. (1) The first or *stimulant stage* is exhibited by excitement and struggling, owing in part to fright and in part to irritation of the respiratory tract by concentrated vapor. There are also coughing and choking in this stage, following the local irritation of the vapor on the respiratory tract. There may be vomiting, and the circulation and respiration are reflexly stimulated. Stimulation now ceases, and depression of the cerebrum, together with the motor, sensor and reflex spinal centres, appears, and ushers in the (2) *anesthetic stage,* characterized by muscular relaxation and complete abolition of consciousness, sensation and motion. Between these two stages—the stimulant and anesthetic—there sometimes occurs a transient state in which sensation is lost before consciousness. This has been styled the *anodyne stage.*

Finally, the (3) *paralytic stage* ensues, accompanied by depression and then paralysis of the three great vital medullary centres controlling the circulation and respiration, together with that of the lowest reflex centres, so that involuntary micturition and defecation occurs. The animal dies of a combination of vasomotor, heart and respiratory failure. If recovery should follow the paralytic stage, the bodily functions return in the reverse order of that in which they were lost; *i.e.,* the lower vital functions first appear, followed finally by the higher cerebral functions.

Uses.—Anesthetics are employed in surgical operations to prevent pain and struggling; in obstetrical operations and in the reduction of fractures, dislocations and hernia, to secure complete muscular relaxation; to overcome spasms and convulsions resulting from disease or poisons; to arrest severe pain in colic; and finally to destroy aged or sick and useless animals.

For fuller details see Anesthesia (p. 275).

(c) *Drugs acting on the cortical motor centres of the brain.*

(1) DRUGS STIMULATING THE MOTOR CENTRES.

Strychnine Physostigmine
Atropine

(2) DRUGS DEPRESSING THE MOTOR CENTRES.

The Bromides	Alcohol
Chloral	Anesthetics

The action of drugs on the cerebral cortical centres has been found by comparing the local effect of electrical stimulation before and after the internal use of drugs.

Uses.—The drugs depressing the cortical motor area of the brain are valuable in convulsions and spasmodic disorders and in motor excitement, particularly in epileptiform convulsions of dogs.

II.—Drugs Acting on the Spinal Cord.

The functions of the cord consist in the conduction of sensory impulses forward to the brain and of motor impulses backward to the muscles; in the origination of nervous force in centres controlling certain functions (sexual, sweating, etc.); and in reflex action by which the cord transmits impulses from sensory to motor tract of the same side of the body, or laterally, from sensory to motor columns on opposite sides.

While drugs probably influence the various centres in the cord, our knowledge of their action is chiefly limited to that exerted on the motor cells of the inferior *cornua*.

If a drug stimulating the motor cells of the cord is given experimentally, slight peripheral irritation will reflexly cause convulsions, and, if the cord is severed from the brain, the same phenomena appear.

(A) *Drugs stimulating the motor cells of the inferior cornua.*

Strychnine	Ammonia	Opium	} Primary action
Brucine	Anesthetics	Ergot	
Thebaine			

Uses.—Strychnine is employed in paraplegia resulting from diseases of the spinal cord after irritation caused by the lesion has passed away.

(B) *Drugs depressing the motor cells of the inferior cornua.*

Physostigmine	Emetine	Salts {	Antimony
Bromides	Turpentine		Silver
Ergot	Salts { Magnesium		Zinc
Nitrites	Sodium		Saponin
Gelsemium	Potassium		
	Lithium		

Chloral	Ether	Nicotine
Morphine	Chloroform	Veratrine
Apomorphine	Camphor	Mercury
Alcohol	Carbolic acid	Arsenic

Uses.—Drugs depressing the motor cells of the cord are serviceable as antidotes in the treatment of poisoning by those exciting the same (chloral and bromides in strychnine poisoning), and in convulsive and spasmodic disorders, as chorea and tetanus.

III.—Drugs Acting on the Nerves

The nerve terminations, rather than their trunks, are influenced by drugs.

(A) *Drugs influencing peripheral sensory nerve-endings.*

(1) *Stimulating sensory nerve-terminations.*—Counter-irritants. (See p. 56).

General Uses.—They are applied externally (mustard and heat) to stimulate the heart and respiration in heart failure, shock and collapse.

(2) *Depressing sensory nerve-terminations.*—These include local sedatives or anodynes, which lessen sensation; and local anesthetics, which abolish sensation.

LOCAL ANODYNES

Aconite	Morphine	Veratrine
Menthol	Chloral	Heat
Carbolic acid	Prussic acid	Cold
Atropine	Sodium bicarbonate	

LOCAL ANESTHETICS

Cocaine	Stovaine	Holocaine	spray {	Methyl-chloride
Eucaine	Novococaine	Cold		Ether

Uses.—The local anodynes are employed to relieve pain of an inflammatory, rheumatic or neuralgic character, and itching. The local anesthetics are employed to prevent pain in surgical operations.

(B) *Drugs influencing peripheral motor nerve-endings.*

(1) STIMULATING MOTOR NERVE-TERMINATIONS

Strychnine	Aconite	Pyridine
Pilocarpine	Nicotine	

(2) DEPRESSING MOTOR NERVE-TERMINATIONS

Curare	Atropine	Prussic acid
Conium	Cocaine	Nicotine
Amyl-nitrite	Camphor	and many others

Uses.—Drugs influencing the peripheral motor nerve-endings are not of any practical therapeutical value.

IV.—Drugs Acting on the Nerves of Special Sense.

(A) *Drugs acting on the eye.*

(1) *Drugs influencing the pupil.*—The mechanism controlling the pupil consists of the centres for the contraction of the pupil (in the corpora quadrigemina ?), the centres for the dilatation of the pupil (in the medulla and acqueduct of Sylvius ?), the third nerve, the cervical sympathetic and the circular and radiating (latter sometimes absent) muscular fibres of the iris. Drugs may act either centrally or locally on these structures. The pupil is dilated by drugs (1) depressing the contracting centre (oculomotor), (2) the terminations of the third nerve or (3) the circular fibres of the iris; and contrariwise, by (4) stimulating the dilating centre, (5) the terminations of the sympathetic or (6) the radial fibres of the iris; and, finally, by a combination of these actions.

Again, the pupil is contracted by drugs stimulating (1) the oculomotor centre, (2) the terminations of the third nerve or (3) circular fibres of the iris; and by depressing (4) the dilating centre, (5) the terminations of the sympathetic or (6) the radial fibres of the iris; and also by a combination of these actions. Drugs may act locally on the pupil through the medium of the circulation as well as when dropped into the eye. Furthermore, absorption and central action may occur when drugs are dropped into the eye as well as when entering the blood through the more ordinary channels.

The drugs used in the treatment of the diseases of the eye are

only those acting locally. Drugs influencing the pupil are divided into two classes: (1) those that contract the pupil (myotics) and (2) those that dilate the pupil (mydriatics).

(1) *Mydriatics.*

(a) ACTING LOCALLY.

Atropine, Homatropine, Hyoscyamine, Hyoscine, Scopolamine, Gelsemine	Paralyse third nerve terminations
Cocaine	Stimulates sympathetic endings.

(b) ACTING CENTRALLY.

Anesthetics (late in their action)

The dilating centre is stimulated by carbonic dioxide in the blood, and therefore dilatation of the pupil occurs in asphyxia; also after irritation of sensory nerves, the sexual organs and digestive apparatus.

Uses.—Mydriatics are useful in dilating the pupil for examination of the eye, and to prevent adhesions of the iris in central corneal ulcers; in keratitis, to overcome photophobia and blepharospasm; and in iritis, to secure rest of the iris and ciliary muscles.

(2) *Myotics.*

(a) ACTING LOCALLY	(b) ACTING CENTRALLY
Physostigmine, Pilocarpine — Stimulate third nerve endings	Anesthetics, Opium

Uses.—Myotics are employed to prevent prolapse of the iris in wounds and ulcers of the cornea; to antagonize the effect of atropine; to prevent the entrance of light in painful disorders of the eye; to lessen intra-ocular tension in glaucoma*; and, in alternation with

* By opening up the filtration angle at the periphery of the anterior chamber and allowing drainage of lymph through the lymph spaces there into the canal of Schlemm, or to contraction of the intraocular vessels, so lessening secretion (Grönholm).

mydriatics, to break up adhesions to the iris. All the local mydriatics and myotics mentioned above act on the ciliary muscle to destroy the power of accommodation. Intra-ocular tension in glaucoma is usually increased by atropine and other mydriatics, but is diminished by eserine.

V.—Drugs Acting on the Ear.

Strychnine makes the hearing (and sight) more acute; while salicylic acid, salicylates and quinine cause, in man, subjective symptoms, including fulness, roaring and buzzing noises in the ears.

Drugs Acting on the Respiratory Organs.

It is impossible to describe under this head all the drugs influencing the respiratory tract. Thus, agents affecting the circulation exert a powerful action on the blood supply and functions of the respiratory organs. The application of counter-irritants and heat and cold externally, reflexly produce notable alterations of pulmonary conditions. Emetics are indirectly serviceable in assisting the expulsion of exudations from the upper air passages in dogs. Furthermore, medicines having a depressing action on the nervous system are of importance in respiratory disorders in relieving cough and spasm. We shall consider here those agents acting on the respiratory apparatus itself.

Drugs Acting on the Respiratory Mucous Membrane.

(A) *Drugs Acting Locally.*

1. Stimulating the mucous membranes and causing vascular dilatation, increased secretion and muscular contraction of the walls.
2. Producing a sedative action.
3. Exerting an antiseptic influence.
4. Relaxing spasm.
5. Causing a local astringent action.
6. Thinning exudations.

Errhines, or sternuatories, are drugs which are introduced into the nostrils to cause irritation, coughing and sneezing and expulsion of secretions, parasites and foreign bodies from the nasal chambers and upper air passages. They are rarely of any value, and include tobacco, ipecac, euphorbium, ammonia, chlorine and sulphurous anhydride.

By inhalation (in pint of water near the boiling point; unless otherwise stated).

(1) DRUGS EXERTING STIMULANT ACTION.

Carbolic acid .....gr.xx.
Creosote .....ɱxx.
Oil of cubebs.....ʒss.
Tincture of benzoin.....ʒss.
Tincture of ipecac.....ʒss.
Oil of turpentine.....3ss.–3iiss.
Oil of pine.....3ss.–3iiss.

(2) DRUGS EXERTING A SEDATIVE INFLUENCE.

Diluted hydrocyanic acid.....(ɱx.–xv. in 3i. cold water).

(3) DRUGS PRODUCING AN ANTISEPTIC ACTION.

Thymol .....gr. vii.–xii.
Carbolic acid .....3i.
Creosote .....ʒss.
Compound tincture of benzoin.....ʒss.
Sulphurous anhydride gas.
Formaldehyde vapor.
Oil of eucalyptus.....ɱx.–xx. (in ʒii. of alcohol).
Oil of cubebs.....ʒss.
Oil of juniper.....ʒss.
Benzoic acid .....3ix. (in ʒviii. of alcohol)
Tar water, undiluted.
Potassium permanganate .....gr.xv.–3i.
Quinine hydrochlorate .....3ss.

(4) DRUGS RELAXING SPASM.

Amyl nitrite .....H., 3ss.–i.; D., ɱii.–v., undiluted.
Extract of belladonna .....gr. ii.–iv.
" " hyoscyamus .....gr. vii.–xv.
" " conium .....gr. viii.
(Burning stramonium leaves).

(5) DRUGS CAUSING A LOCAL ASTRINGENT ACTION.

Alum .....3ss.
Zinc sulphate .....3ss.
Solution of ferric chloride.....3l.
Silver nitrate .....3ss.

(6) DRUGS THINNING SECRETION.

Sodium bicarbonate .....3ss.
Solution of lime, undiluted.
Ammonium chloride .....3ss.
Vinegar .....℥ii.
Lactic acid .....℥i.

Uses.—Inhalations are often beneficial in the treatment of coryza, pharyngitis, laryngitis, tracheitis and bronchitis. In the first stage of catarrhal inflammation of the upper air passages, antiseptics may cut short the attack. Simple steaming with vinegar or sodium bicarbonate moistens and soothes the dry, irritable mucous membrane and relieves congestion by promoting secretion. In the exudative stage, agents stimulating the respiratory mucous membrane and making the secretions less viscid are in order. If the mucous or purulent discharges are excessive, astringent sprays or inhalations are useful; and if they are foul-smelling, drugs combining stimulant and antiseptic actions may be employed. Inhalations may be given by means of a bronchitis kettle, or by atomization to small animals. Care must be exercised that too large a quantity of the solution be not used lest absorption and poisoning ensue. Dogs may be placed over the perforated seat of a cane-bottomed chair with the steaming apparatus underneath.

A hot brick is sometimes employed to give inhalations to horses by dropping it into a pail containing the proper solution. The head should not usually be covered during inhalation if the breathing is embarrassed or the respiratory tract obstructed, since fresh air is imperative. Simple steaming may be conducted for an hour. Inhalations containing special drugs may be given for fifteen minutes.

(B) *Drugs Acting Systemically.*

Expectorants are agents which influence the bronchial mucous membrane and its secretion. They aid or hinder expectoration in man, but are much less efficient in this respect in veterinary medicine, because the act of expectoration is performed with difficulty by the lower animals. Nevertheless, expectorants are useful in altering the character of the secretion and lessening the irritation

caused by dry, tenacious discharges, and in stimulating the mucous membranes and improving their circulation and nutrition. Moreover, some drugs (volatile oils) exert an antiseptic action on the bronchial mucous membrane during their elimination.

Expectorants.

(1) Increasing Secretion

Depressing the heart and lowering vascular tension ("depressing expectorants")

Apomorphine	Ipecac	Antimony and potassium tartrate
Potassium iodide	Pilocarpine	

Stimulating the heart and increasing vascular tension ("stimulating expectorants")

Ammonium chloride	Sulphur	Terpin hydrate
Squill	Tar	Terebene
Camphor	Turpentine	Volatile oils
Balsams		

(2) Diminishing Secretion

Belladonna	Stramonium	Opium
Hyoscyamus	Acids	

Volatile oils, and drugs containing them, first increase and then decrease bronchial secretion as a secondary effect

(3) Altering the Nutrition of Bronchial Mucous Membrane

Potassium iodide	Cod liver oil	Sulphur
Ammonium chloride		

(4) Exerting an Antiseptic Action

Turpentine	Tar	Balsam of Tolu
Terebene	Ammoniacum	Cubebs
Terpine hydrate	Balsam of Peru	Copaiba

(5) Locally Stimulating and Antiseptic to Mucous Membranes

Creosote	Eucalyptol	Guiacol

Uses.—Expectorants are chiefly prescribed in bronchitis. In the early or dry stage drugs increasing secretion and at the same time depressing the circulation are often employed in sthenic cases.

These drugs possess less value in the treatment of the horse, on account of comparative insusceptibility to them, than in the case of dogs.

If exudation is excessive, then drugs lessening secretion are indicated. When the disorder is persistent, agents altering and improving the nutrition of the bronchial mucous membrane are beneficial. Bronchitis accompanied by a copious foul secretion is treated with volatile oils, which exert an antiseptic action on the air passages. Expectorants are usually administered with other agents influencing the respiratory tract; *e.g.*, drugs relieving cough and spasm and those stimulating the respiratory movements or circulation.

Drugs Stimulating the Respiratory Centres.

Strychnine	Cocaine	Stramonium
Atropine	Belladonna	Ammonium carbonate
Caffeine	Hyoscyamus	Strong ammonia

External counter-irritation and heat.

Drugs Depressing the Respiratory Centres.

Morphine, codeine and heroine are sedative to the respiratory centre and thus useful in cough, asthma and dyspnœa.

Uses.—Drugs stimulating the respiratory centres and movements are of great value in diseases of the chest—especially bronchitis—attended with obstruction in the air passages and cyanosis. They promote coughing and efforts at expulsion of secretion and facilitate the entrance of oxygen into the blood. Some, possibly ammonia, stimulate the movements of the cilia lining the tracheal mucous membrane.

Strychnine is, perhaps, the most powerful respiratory stimulant; atropine is indicated where exudation is abundant, while ammonium carbonate is prescribed to increase secretion. Certain drugs sometimes cause in large doses Cheyne-Stokes breathing in animals, *e.g.*, opium, chloral, bromides, digitalis, ammonium carbonate and strychnine, owing to disturbance of the respiratory centre.

Drugs Relaxing Spasm of the Bronchial Muscular Tunic and Relieving Cough

LOCALLY

White of egg	Linseed tea
Mucilage	Syrups

External counter-irritation and heat.

SYSTEMICALLY

Opium	Nitrites
Codeine	Chloral
Hyoscyamus	Bromides
Stramonium	Chloroform
Cannabis Indica	Phenacetin

Uses of Drugs Allaying Spasm and Cough.

Coughing is a reflex act following irritation of sensory nerve endings in any part of the respiratory tract (usually of afferent vagal branches), in the pharynx, pleura, ears, teeth, stomach and liver. Sensory impulses conveyed to the reflex centre for coughing, —near the respiratory centre in the medulla,—are there transformed into motor impulses and result in coughing. Drugs may stop coughing by acting locally to relieve congestion and irritation (demulcents) or they may exert a topical sedative action on the nerve endings. They also act systemically by quieting the reflex centre for coughing, or the sensory or motor nerve endings; also by abating congestion in promoting secretion (expectorants), or in influencing the circulation.

Cough may be beneficial when it assists the expulsion of exudation, but is not so when it is constant and ineffective, as in congestion of the trachea, bronchial mucous membranes, lungs or pleura; in pulmonary consolidation; and in coughs originating outside of the respiratory tract. We should try to arrest coughing by agents removing the cause (congestion or irritation), such as counter-irritants, expectorants, local applications (sprays, inhalations) and heart stimulants, but if these are inefficient and coughing is immoderate, we may resort to the use of sedative agents. Some preparation of opium is most frequently employed to stop coughing, but should be avoided if cyanosis exists, since inspiratory and expulsive efforts are

weakened by the drug. Belladonna, on the other hand, stimulates the respiratory centres and arrests cough by depressing both the afferent and efferent vagal terminations in the lungs, while—like opium—lessening secretion. These drugs are often combined. When spasm of the bronchioles exists, as in asthma, and sometimes in bronchitis, the nitrites are particularly valuable.

Drugs Acting on the Urinary Organs

Diuretics are drugs increasing the secretion of urine. Four factors are concerned with urinary flow. (1) The composition and viscosity of the blood. (2) The state of local (renal) and general blood pressure. (3) The activity of the renal cells. (4) Reabsorption or rapidity of flow of urine in the constricted tubes. The renal mechanism influenced by drugs comprises:

(1) *The Malpighian glomerules,* which excrete alkaline fluid, urea and salts, and other substances from the blood by osmosis. Their activity depends upon their blood supply, which is increased by agents causing dilatation of their afferent arterioles, thus accelerating the velocity and flow of blood to the glomerules; and by drugs increasing general blood tension without corresponding constriction of the renal vessels. Drugs augmenting the mass of blood and tension in the Malpighian bodies enlarge the surface of cubical epithelium covering the capillary loops and promote osmosis or filtration of fluid into the cavity of the Malpighian capsule. There is also some true secretion by the cells lining the glomeruli. Sugar, peptone and egg albumin injected into the blood are excreted by the glomeruli.

(2) *The nucleated polyhedral cells lining the convoluted tubes.* —These secrete the solid products resulting from the retrograde metamorphosis of nitrogenous bodies circulating in the blood, as urea, uric acid, creatin, and other organic substances, pigment, phosphates and water.

(3) *The constricted tubes.*—These regulate the urinary secretion by either impeding its passage by constriction of their walls, thus aiding absorption, or by their active peristalsis facilitating the flow of urine.

(4) *Nervous mechanism.*—This governs the calibre of the vessels of the Malpighian bodies, and possibly controls the unstriped muscle of the constricted tubes. No secretory nerves, such as those controlling the secretory cells of the salivary glands, have been discovered in the kidneys. Variations in the blood-supply are apparently sufficient to account for the secretion of urine.

The flow of urine is therefore chiefly regulated by the vasomotor system, with centres in the medulla and thoracic and lumbar cord. The constrictor and dilator fibres run in the splanchnics, through the renal plexus, enter the kidney at the hilum, and accompany the arteries to their final endings. We may classify diuretics broadly in two groups: (1) Those acting chiefly upon the glomerules. (2) Those affecting mainly the renal cells of the tubules.

(1) *Diuretics increasing the glomerular fluid.*

Water is the chief diuretic. Without an abundance of water diuresis is impossible. This fact is often lost sight of. Water is absorbed from the bowels (hardly at all from the stomach), where it becomes salt solution by taking up sodium chloride from mucus or food, or from superficial cells of the tract, or from that formed by the neutralization of HCl from the stomach. Water then enters the blood as an isotonic or hypotonic salt solution, increasing its mass (hydremic plethora) and its pressure, thus dilating the renal arterioles and augmenting the flow of urine. Experimentally, Raphael doubled his urinary output by doubling his intake of water. But the most powerful drug (diuretin) only enhanced his urinary flow 50 per cent. The salts act chiefly upon the glomerules. When hypertonic salt solutions enter the blood they increase its osmotic pressure and water passes into the blood from the tissues. The osmotic pressure is then lowered, but the mass of blood is increased, together with vascular tension, and thus dilatation of the renal vessels, and diuresis. The most diuretic salts include potassium acetate, citrate, bitartrate, and solution of ammonium acetate. Sodium chloride and sulphate; potassium nitrate, bicarbonate and iodide; and magnesium salts; may act as diuretics, but not so certainly. Digitalis, squill and strophanthus are powerful diuretics when the circulation is poor, with venous engorgement and low pressure, by overcoming this condition and increasing the flow of blood through the arterioles

of the glomerules. They may, like many diuretics, have a local action to dilate arteries in the kidneys and to stimulate renal cells, but this is doubtful. The nitrites are diuretic if they dilate the renal arterioles more than the arterioles generally.

(2) *Diuretics stimulating the renal cells, or lessening absorption from the tubules, or both.*

The matter of absorption from the tubules is disputed. Some authorities deny that resorption of water or other substances plays any important part in urinary secretion. Caffeine and theobromine act chiefly through powerful stimulation of the renal cells of the tubules, besides dilating renal vessels through excitation of the heart and augmenting blood pressure. The irritant diuretics contain volatile oils, resins or aromatics, as buchu, juniper (gin), turpentine and cantharides. They stimulate the renal cells, or hinder resorption, or both. Urea is the natural stimulant of the renal cells. The irritant glucocides, scoparin and asparagin, act as renal stimulants. Calomel either stimulates the renal cells, or causes diuresis indirectly, in relieving venous engorgement (which obstructs flow in the renal arterioles) by its cathartic action. Diuretics may lessen resorption in the tubules by either hindering the absorbing power of the tubules, or by hastening the flow of urine through them. The solids in the urine are chiefly increased during the first few days after the use of diuretics.

Diuretics, according to Fischer's recent and much discussed theory, act through influencing the colloid chemistry of the renal cells. Production of acid in the renal cells leads to their swelling, edema and lack of function. All salts, glucose and alkalies antagonize this condition, reduce edema of the renal cells, allow water to pass through them, and are all diuretic. Acidosis and edema of the renal cells is brought about by lack of oxygen—hence caffeine, digitalis and agents improving renal blood supply are diuretics in supplying oxygen. Salts and sugar dehydrate tissue, therefore common salt, sucrose, glucose and lactose are diuretics in abstracting water from the tissue and renal cells.

Uses.—Diuretics are useful in removing deleterious and waste solid matters in the blood resulting from disease or the imperfect oxidation of albuminoid substances. Their action depends on an extra ingestion of water. In fevers the potassium nitrate and other

potassium salts are employed with spirit of nitrous ether, alcohol and digitalis. They are antipyretics by eliminating pyrogenic material. Tissue waste is increased by diuretics, and they are serviceable in plethora, rheumatism and obesity. In acute disease of the kidneys, salines and digitalis are indicated; in chronic renal disorders more stimulating agents are often used, as juniper, buchu, etc. Diuretics remove water from the system. They are, therefore, employed in edema and dropsy of renal or cardiac origin, and in chronic effusions, as in pleuritis and pericarditis. Blood tension is lowered by withdrawal of water from the blood, and congestion may be relieved in various parts of the body. Diuretics lessen irritation of the kidneys by diluting the urine when the secretion is concentrated or contains toxins or other irritants (uric acid, calcium oxalate, etc.). Finally, stimulating diuretics (buchu, turpentine, etc.), are indicated in chronic inflammatory diseases of the kidneys and bladder, and in relaxed and paretic disorders of the bladder (incontinence of urine) to excite the reflex and motor functions of the sphincter and detrusor muscles.

Drugs Influencing the Reaction of Urine.

In man and animals secreting an acid urine, the basic phosphates of sodium and potassium in the blood are decomposed by the renal cells, and acid phosphate of sodium or potassium—being more diffusible—are eliminated, giving the urine its characteristic reaction, while the bases remain behind. In the case of the herbivora the urine is alkaline, because there are larger quantities of magnesium and calcium salts in the food, which precipitate phosphoric acid in the stomach, and because there is an excess of alkaline sodium and potassium salts in the blood. The urine may best be made acid by benzoic acid, which is converted into hippuric acid during its passage through the kidneys. Salicylic acid, urotropin, the mineral acids (as acid salts), and large quantities of the vegetable acids and boric acid tend to acidify the urine in a less degree. An acid urine may be made alkaline by alkalies, as salts of potassium, lithium, sodium and calcium, together with the vegetable salts, tartrates, citrates and acetates, which circulate as carbonates in the blood. Drugs promoting diuresis make the urine less acid because the basic sodium phosphate in the blood is not so readily broken up in the kidney when it diffuses through the cells in great dilution. Ammonia fails to make the urine alkaline because it is transformed into urea.

Uses.—Benzoic acid is sometimes of benefit in acidifying and disinfecting an alkaline decomposing urine of pyelitis or cystitis. Recently urotropin has been used more successfully for these pur-

poses. The alkalies are thought to be useful in alkalizing the blood in certain disorders (rheumatism, hemoglobinemia, etc.), and the urine of carnivora, to prevent the precipitation of uric acid in the urine or to aid its solution when already precipitated.

Drugs Influencing the Composition of Urine.

Drugs contracting the efferent vessels of the Malpighian bodies diminish the flow of blood and urea-excretion and increase the elimination of water; while those dilating the afferent vessels cause more blood to pass through the kidney and promote the secretion of solids and water. Drugs stimulating the cells of the convoluted tubes augment especially the urinary solids. The composition of the urine is also altered by most drugs eliminated in it, leading to changes in color, odor, reaction and the appearance of blood pigment, etc.*

Urinary Antiseptics.

Certain drugs are sometimes given with the purpose of killing bacteria in the urine in purulent pyelitis and cystitis. Among these are:

Urotropin	Methylene blue	Copaiba
Benzoic acid	Salicylic acid	Cubebs
Boric acid	Salol	Volatile oils
	Buchu	

Urinary Sedatives.

The foregoing list, in preventing decomposition, and:

Hyoscyamus	Opium
Belladonna	Alkalies (with an acid urine)

* Thus blood appears in the urine after toxic doses of turpentine, cantharides and salicylic acid; and blood pigment, in poisoning by potassium chlorate, acetanilide, nitrites, glycerin and mushrooms (muscarin); and occasionally by overdoses of mineral acids, naphtol, naphtalin and arsenic. Rhubarb and senna impart their coloring matter (chrysarobin) to urine, which makes acid urine brown, but alkaline urine a deep blood or purplish red. Carbolic acid, creosote, naphtalin and other tar-products, together with gaultheria and uva ursi (due to contained arbutin), stain the urine a greenish-brown or blackish hue. Santonin dyes an alkaline urine cherry or purple-red, while an acid urine is turned yellow or greenish. Logwood gives its color to acid urine, while an alkaline urine is rendered red or violet. Poisonous doses of sulphonal and trional give rise to a claret-colored urine, owing to hematoporphyrin. Gamboge and carrots bestow their colors on the urine. Turpentine is said to give urine the odor of violets, but large doses impart the peculiar odor of the oil itself. Cubebs, copaiba, eucalyptus, valerian, musk, asafetida, sandal wood oil, asparagus and turpentine (large doses) communicate their special odor to the urine.

Drugs Acting on the Sexual Organs.

(A) Influencing Chiefly the Male Generative Organs.

The mechanism concerned with the sexual functions is presided over by cerebral and spinal lumbar centres. Agents may immediately excite the spinal centres or cause local irritation of sensory nerves in various parts of the body—more particularly in the neighborhood of the genital organs—and thus reflexly stimulate the lumbar centres.

The cerebral centres are mainly affected by visual, nasal or oral impressions, and also reflexly by irritation of sensory nerve-endings, more especially those situated in the sexual organs.

(1) *Aphrodisiacs* are drugs exciting sexual desire (and increasing sexual power in the male). They include:

DIRECT APHRODISIACS

Strychnine, Phosphorus, Alcohol (act on centres)
Cantharides (local irritant)
Yohimbine (causes congestion of the sexual organs).

INDIRECT APHRODISIACS

In debility: Iron, Strychnine, Arsenic (full diet)

(2) *Anaphrodisiacs* are drugs lessening sexual desire. They are:

Opium, Bromides, Purgatives, Nauseants, (bleeding), (spare diet)

Uses.—Aphrodisiacs may sometimes be useful in impotence and loss of sexual desire. Irritants, as cantharides, may cause inflammation of the urinary tract. Loss of sexual desire and power should usually be treated by improving the general nutrition with tonics and good feeding and by regulating the use of the sexual organs, unless the trouble is due to organic disease. Drugs diminishing sexual appetite may be useful in quieting the centres and rendering them less sensitive to sources of local irritation. It is, however, more sensible to remove the cause of irritation, as smegma preputii, acid urine, urinary calculi, intestinal parasites, scybala, fissure of the rectum, hemorrhoids, etc. Anaphrodisiacs may be employed to subdue excessive sexual excitement and nervousness (hysteria) sometimes accompanying "heat" in the female.

(B) Influencing the Female Sexual Organs.

(1) *Emmenagogues* are drugs which favor the occurrence of "heat" (ovulation) in the female when it is irregular or abnormally absent. We are at present ignorant of their exact mode of action. Some act directly, perhaps, by stimulating the centres or sexual organs.

DIRECT EMMENAGOGUES

Savin, Rue, Cantharides (irritants)
Ergot

INDIRECT EMMENAGOGUES

Purgatives (Aloes)
In debility: Iron, Arsenic, Strychnine (full diet)

Uses.—The irritant emmenagogues are usually ineffectual in medicinal doses, while they may cause inflammation of the urinary tract and abortion (in pregnant animals) in large doses. The use of the indirect emmenagogues is more rational and effective. Aloes is thought to stimulate the uterus reflexly by irritation of the large intestines, and may also act locally on the uterus after absorption. Absence of estrum, ordinarily a symptom resulting from a general or local condition, should be treated if possible by removing the cause (debility, plethora, deformity).

(2) *Ecbollics,* or *oxytocics,* are drugs stimulating uterine contraction during or directly after parturition. The exact physiological details concerned in their action are unknown except in the case of ergot (p. 557). They are:

Ergot	Quinine
Cotton root bark	Hydrastis
Corn smut	Savin

(3) *Drugs restraining uterine contractions.*

Anesthetics	Chloral
Opium	Bromides
Cannabis Indica	

Uses.—Ecbollics (preëminently ergot) are used to contract the uterus and arrest hemorrhage after parturition; or to stimulate the womb during parturition in inertia. In poisonous doses they may lead to abortion during pregnancy. Drugs restraining uterine contraction (especially opium) are sometimes given to prevent threatened abortion.

(4) *Drugs influencing milk-secretion.*

(a) Galactagogues are drugs increasing the flow of milk. They include:

Extracts of the pituitary and mammary glands.	Alcohol (full diet)
Pilocarpine	Leaves of castor oil plant (internally or locally on udder as poultice).

Drug treatment is practically valueless in increasing the secretion of milk; rich feeding is the chief desideratum. Many drugs are eliminated in milk and may produce their characteristic effects in animals or man drinking it. Among these are:

Opium	Arsenic	Copper
All volatile oils	Mercury	Carbolic acid
Purgative salts	Lead	Colchicum
Rhubarb	Zinc	Euphorbium
Senna	Iron	Ergot
Castor oil	Bismuth	Salicylic acid
Scammony	Neutral salts	Veratrine
Jalap	Ammonia	Strychnine
Iodine	Acids	Croton oil
Potassium iodide	Sulphur	Aloes
Antimony	Atropine	Turpentine

(b) *Antigalactagogues.*—Belladonna is the only efficient drug lessening the secretion of milk, applied locally or given internally. It paralyzes the peripheral secretory nerve-endings and is useful in mammitis by diminishing the circulatory activity in the mammary gland.

Drugs Influencing Metabolism.

(1) *Alteratives.*—The term "alterative" is a vague, indefinable word used to describe the action of certain drugs modifying tissue change and improving nutrition in some disorders. The word is simply a cloak for ignorance and should be dropped. The value of alteratives has been discovered by clinical experience. The following are often classed as alteratives:

Arsenic and its preparations	Phosphoric acid
Mercury and its salts	Colchicum
Iodine and its salts	Sarsaparilla
Cod liver oil	Sulphur

Uses.—Alteratives are employed in those diseases in which experience has proved them to be beneficial.

Tonics.—The word "tonic" is another term even more vague and all-embracing than "alterative," and, therefore, impossible to define precisely. Tonics improve the general nutrition and health, and, as ordinarily understood, refer to drugs promoting appetite and digestion (bitter tonics, as gentian); the state of the blood (hematinics, as iron and arsenic); or the condition of certain organs (heart tonics, as digitalis; nervines, as strychnine).

Tonics are indicated in the treatment of debility (general or special) and anemia.

Drugs Influencing Bodily Heat.

Antipyretics are drugs lowering the temperature of the body in fever. The mechanism concerned with temperature changes is as follows:

1. *Heat Production.* There are centres for heat-production at the base of the brain (tuber cinereum and corpus striatum), and less important heat-producing centres in the upper part of the spinal cord.

2. *Heat Loss.* There are centres for heat loss in the cerebrum (cruciate and sylvian), and also at the base, in the tuber cinereum, increasing the frequency of respiration. Then the vasomotor and respiratory centres in the medulla and the sweat centres (probably also situated in the medulla) all contribute to heat loss. This follows from the loss of heat through evaporation of sweat, by the dilatation of the superficial vessels in the absence of sweating, and through the more rapid exchange of air caused by increased frequency of respiratory movements. Heat is also lost in the passage of urine and feces.

3. *Heat Regulation.* There are centres in the tuber cinereum, and less important centres in the corpus striatum, which coordinate or adjust the relations between the heat-producing centres and the centres for heat-loss. The result is the uniform, normal temperature existing in health whereby the production of heat, caused chiefly by muscular activity and favored by constriction of the superficial vessels, is balanced by loss of heat—through flushing of the surface vessels, or sweating, and by lessened muscular action and more rapid respiration. In the body the fall of a few degrees of temperature causes shivering or violent muscular action, together with marked constriction of the cutaneous vessels, which leads both to greatly increased heat production and diminished heat loss.

The heat-regulating centres may be compared to the thermostat set to keep the temperature of rooms at a fixed point. This instrument acts through the expansion and contraction of metal whereby the heat is turned on or off. As in the thermostat, which preserves a uniform temperature by regulating the heat-production and heat-loss, so in the body the heat-regulating centres are set to keep the temperature at the normal point for the species. As one may set the temperature in the thermostat at any given point, within reasonable limits, so in the body the heat-regulating centres may be set at a higher or lower level. In fevers toxins set the heat-regulating centres at a higher point, while certain drugs set these centres at a lower level. The highest temperatures follow violent muscular action in the rigors of certain fevers. When the heat-regulating centres regain control, and stimulate the centres for heat-loss, sweating occurs and the fever rapidly falls (malaria). Fever is due chiefly to increased heat-production, combined with a certain diminution in heat-loss.

Very recently it has been discovered that adrenalin secretion plays an important rôle in the production of fever. Adrenalin seems to be essential as an activator of the brain, enabling it to convert latent energy into heat and motion. The brain, liver and adrenals form a kinetic system for this end. To use a mechanical simile, the brain is the battery, adrenalin is the oxidizer, the liver is the gasoline tank (glycogen), and the muscles are the furnace in which combustion occurs. To go a step further it appears that the thyroid gland is the pacemaker, since it regulates the rate of discharge of energy.

Is fever beneficial? Artificial heating of animals to a temperature of 104° F., after injection with fatal doses of bacteria, caused half to survive while all the controls died. Again, the factitious production of a chill in animals subjected to experimental infections, caused a subsequent fever and cure of the infection. Fever is probably the result of toxins. Whether these do or do not directly act on the heat-regulating centres is unknown.

Action. Now as to the precise action of antipyretics. Some act by diminishing metabolism, as quinine. Some dilate the superficial vessels and may also cause sweating, as salicylic acid, alcohol, ammonium acetate, nitrous ether, opium and ipecac. Some act by depressing the circulation, as aconite, veratrum, digitalis, antimony and venesection. These lessen metabolism. The modern, coal-tar

antipyretics, as acetanilid, antipyrin and phenacetin, act directly on the heat-regulating centres, either to increase their resistance to the action of the toxins of infections, or to lower the point at which the temperature of these centres is set—to use the thermostat analogy. Such agents also strengthen the control of the heat-regulating centres over the centres for heat-loss, and may or may not cause sweating. In excessive doses their depressing effect on the circulation is so marked that collapse may occur. That they act centrally is shown by the fact that they fail to act when the spinal cord is cut. They do not act in health because of the absence of disturbance of the heat-regulating centres by toxins. They do not act by diminishing heat-production—as has been hitherto taught—since metabolism is not notably lowered by them. Acetanilid increases metabolism. They do not depend upon sweating, as they act under the influence of atropine which prevents diaphoresis.

Uses. Antipyretics are used to diminish fever. It is wiser to employ the coal-tar products for this purpose because they are not only more effective but also promote comfort by their sedative influence on the nervous system. They are, however, generally counter-indicated unless fever is high or long-continued, since it has been pointed out that high temperature is a natural protective agency in destroying toxins and bacteria. Cold is the best antipyretic measure, when it can be employed, in not only lowering fever and increasing the elimination of toxins in the urine, but in powerfully stimulating the vital nerve centres. (See p. 632.)

Drugs Acting on the Skin.

(A) Drugs Influencing the Blood Vessels of the Skin.

(1) *Locally dilating superficial vessels.*

IRRITANTS OR COUNTER-IRRITANTS.

Cantharides
Iodine
Mustard
Capsicum
Croton oil
Oil of turpentine and other volatile oils
Ammonia water
Camphor
Red mercuric iodide
Corrosive mercuric chloride
Arsenous acid
Silver nitrate
Zinc chloride
Carbolic acid
Mineral acids
Caustic alkalies
Anesthetics and alcohol (when evaporation is prevented)
(Heat)

Drugs are classified as follows, according to the degree of irritation they produce:

Rubefacients are drugs which cause vascular dilatation and redness of the skin when locally applied, such as mustard and iodine (and heat).

Vesicants are drugs producing inflammation of the skin and exudation of serum under the epidermis (vesicles), when locally applied, such as cantharides.

Pustulants are drugs inducing a still higher grade of inflammation when locally applied, accompanied by migration of leucocytes from the vessels into the vesicles, forming pustules.

Caustics, or *Escharotics,* are agents which, when locally applied, lead to so great a degree of irritation that the vitality of tissues is destroyed, *e.g.,* nitric acid, caustic potash and the white-hot iron.

Uses.—Irritants are often called counter-irritants when they are used against (counter) existing irritation or inflammation by reflexly causing contraction of vessels in congested or inflamed underlying parts. Thus a blister on the chest leads to contraction of the vessels in the inflamed pleura and relieves pleuritis. Counter-irritants are, therefore, employed locally to overcome internal congestion and inflammation. Rubefacients are often applied over the whole surface of the body (mustard and turpentine) to dilate superficial vessels and equalize the circulation in colds, chills and internal congestions. Vesicants are used to alter the circulation and nutrition of adjacent parts and to secure resolution and absorption of inflammatory products in joint and periosteal disorders. (For details see Counter-irritants, p. 626.)

(2) *Locally contracting superficial vessels.*

Astringents are drugs which, when locally applied, make the tissues drier and denser and lessen secretions. Their action is probably dependent on various factors: partial coagulation of the albuminous fluids of the tissues; coagulation of morbid secretions; removal of water; and contraction of the musular coat of the blood vessels. They are local irritants with the exception of lead acetate and bismuth salts. The astringents are:

Salts	Lead	Adrenalin	
	Aluminum	Tannic acid, and drugs containing it	
	Zinc	Hydrastis	
	Silver	Cocaine	
	Copper	Antipyrin	
	Ferric	Methylene chloride	On evaporation
	Bismuth	Ether	On evaporation
	Hamamelis	(Cold)	
	Ergot		

Styptics, or *Hemostatics,* are drugs which arrest hemorrhage, when locally applied, both by coagulation of albumin of the blood and by direct contraction of the vessels and tissues surrounding them. Adrenalin and solutions of ferric alum, ferric chloride and subsulphate are the most powerful styptics, although all astringents possess an hemostatic action.

Uses.—Astringents are employed in local loss of tone and relaxation of tissues accompanied by serous, mucous or purulent exudation from mucous membranes or raw surfaces. The irritating astringents are usually contra-indicated in acute inflammatory conditions, but are thought to prevent the out-wandering of leucocytes through the blood vessels, which results in purulent exudation.

Styptics are employed in the treatment of hemorrhage from mucous membranes, or in bleeding from other parts which cannot be stopped by surgical means, heat or cold. The coagulated blood is prone to sepsis, speedy decomposition and infection.

(B) Drugs Locally Softening, Soothing and Protecting the Skin, or Emollients.

They include:

Lard	Olive oil
Petrolatum	Cottonseed oil
Cacao butter	Lanolin

(Fomentations—Poultices)

Demulcents are drugs exerting a soothing, protecting and softening influence on the mucous membrane of the alimentary canal, when given internally. They are mostly gums, syrups and albuminous fluids, as:

Acacia	Glycerin
Linseed infusion or tea	White of egg
Liquorice	Milk
Syrup	Starch
Molasses	Sweet oil
Honey	

Uses.—Emollients are serviceable in softening the skin when it has a tendency to be dry and fissured; also in chafing and superficial inflammation when emollients protect the skin from the natural irritation of the air.

Demulcents are of value in inflammation of the mucous membrane of the digestive tract (olive oil, not starch or gums, which may decompose and irritate), and again in catarrh of the mucous membrane of the upper respiratory tract, because they do not exert a direct sedative influence on the throat, but, either reflexly or in some

measure directly, act on the bronchial tubes. Demulcents are often employed to relieve irritation in the urinary tract, but after their decomposition in the alimentary canal and absorption into the blood they can not act as such. They act chiefly by supplying water.

(C) Drugs Influencing the Secretion of Sweat.

The mechanism controlling the sudoriferous glands and secretion of sweat, comprises sweat centres in the spinal cord; secretory nerves proceeding from them with terminations in the glands; the gland cells, and blood vessels of the skin. Any portion of this mechanism may be affected by drugs to increase or diminish sweat secretion.

(1) *Drugs increasing the secretion of sweat, or diaphoretics.* They may:

(1) Stimulate the sweat centres.

(2) Excite the secretory nerve-endings in the glands.

(3) Increase the activity of the gland cells.

(4) Stimulate the vasodilators and increase the vascularity of the skin. Stimulation of the secretory and vasodilator nerves usually go hand in hand, since they accompany each other in their course to the sweat glands.

DIAPHORETICS

Pilocarpine Alcohol Spirit of nitrous ether Nitrites Volatile oils reflexly stimulate the circulation, as camphor Heart stimulants Ipecac and nauseants relax vessels External heat (Warm drinks)	Pilocarpine stimulates the gland cells, or secretory nerve-endings. The others act indirectly by promoting the vascularity of the skin, and thus the activity of the sweat glands.
Antimony salts Solution of ammonium acetate Opium Camphor Ipecac	Stimulate sweat centres
Potassium acetate Potassium citrate Aconite	Action unknown

(2) *Drugs diminishing the secretion of sweat, or anhidrotics.*

They may depress the various parts of the mechanism which are stimulated by diaphoretics. They are:

Atropine	Paralyze secretory nerve-endings	Acids	Action undetermined
Belladonna		Zinc salts	
Hyoscyamus		Nux vomica	
Stramonium		Quinine	
(Cold externally)		Salicylic acid	

Uses.—There are two indications for the use of diaphoretics. *First,* to bring blood to the surface and to cause sweating, thus equalizing the circulation in "colds," chills and congestions and reducing temperature in fever by evaporation and radiation of heat from the skin. Ammonium acetate, alcohol and spirit of nitrous ether are commonly used in the treatment of the disorders first noted, but acetanilid and phenacetin are more powerful antipyretics. *Second,* to eliminate morbid material from the blood in failure of the kidneys, as urinary suppression, or uremia. These conditions are comparatively rare in veterinary practice. The skin of the lower animals generally is much less responsive to diaphoretics than that of man, while horses and cattle are more susceptible to these agents than dogs, cats or pigs.

A warm covering and atmosphere assist the dilation of the peripheral vessels and activity of the gland cells and should always be secured to aid diaphoresis. Anhidrotics are of little service in veterinary medicine. Excessive sweating is usually a sign of debility and is remedied by rest, tonics and good feeding.

Drugs Which Destroy Microorganisms and Parasites.

(1) *Disinfectants or Germicides* are agents which destroy the microörganisms causing infectious and contagious diseases, fermentation and putrefaction. Examples:

Corrosive mercuric chloride	Sulphurous acid
Carbolic acid	Chlorine
Lime	Heat
Chlorinated lime	

(2) *Antiseptics* are agents which prevent the growth and development of the microörganisms occasioning fermentation, putrefaction and disease; more especially the micrococci producing suppuration. Those used externally for surgical purposes are:

Iodine and its tincture	Potassium permanganate	Iodol
Alcohol	Zinc chloride	Boric acid
Carbolic acid	Zinc sulphate	Benzoin
Corrosive sublimate	Formalin	Thymol
Creolin	Iodoform	Balsam of Peru
Lysol	Salicylic acid	
Hydrogen dioxide	Aristol	

Antiseptics which are given internally:

Naphtol	Bismuth salicylate
Salol	" subnitrate
Creolin	Quinine
Carbolic acid	Volatile oils and others

Deodorants, or *Deodorizers,* are agents which destroy or counteract a foul odor. Those possessing any real value are also disinfectants and antiseptics, and remove the source of the odor.

(For further details see special article on disinfectants, antiseptics and deodorants, p. 643.)

Anthelmintics or *Vermicides* are drugs which kill intestinal worms, as the various species of tænia (tape worm); of ascaris (round worms) and oxyuris, thread, seat or whip worm, inhabiting the alimentary canal of the domestic animals. They are absorbed with difficulty, or they would poison the host as well as the parasites.

Anthelmintics inimical to tænia are:

Aspidium (horse and dog)	Calomel	Aid in expulsion of dead parasites
Oil of turpentine	Arsenic	
Kousso	Aloes	
Areca nut (sheep and lambs)	Linseed, cotton-seed or castor oil	
Pumpkin seed		

Anthelmintics destroying ascarides:

HORSES.

Creolin	Gentian	Tonics
Aloes	Iron	
Oil of turpentine	Arsenic	
Arsenic	Copper sulphate	
Calomel		

DOGS.

Areca nut	Santonin	Spigelia

Anthelmintics killing oxyurides.

Rectal injections containing salt, solution of lime, quassia, iron salts, alum and oil of turpentine are used to destroy these parasites infesting the lower bowel.

Anthelmintics destroying strongylidæ.

Thymol	Turpentine	Asipidium

Anthelmintics destroying œstri equi ("Bots").

Carbon disulphide	Hydrochloric acid	Tonics
Chloroform	Bitters	
	Iron	
	Arsenic	
	Copper sulphate	

Vermifuges are purgatives (as aloes and oil) used to expel dead parasites from the bowels after the administration of anthelmintics.

Parasiticides, or *antiparasitics,* are drugs which destroy parasites, more especially those inhabiting the skin. We may classify them as those used:

(1) *Against Tinea* (Ringworm and Favus).

Mercurial ointments	Chrysarobin ointment	Salicylic acid
Tincture of iodine	Cantharides	Boric acid
Glycerite of carbolic acid	Croton oil	Thymol
Creolin	Formalin	Sulphurous acid
Creosote		

(2) *Against Acari.* (Scab, itch and mange).

Sulphur	Carbolic acid
Tar	Corrosive sublimate
Peruvian balsam	Salicylic acid
Styrax	Cantharides

(3) *Against Pediculi.* (Lice.)

Staphisagria	Carbolic acid
Oil of tar	Creolin
Peruvian balsam	Tobacco
Styrax	Pyrethrum
Oil of anise	

(4) *Against Pulex irritans.* (Flea.)

Pyrethrum	Oil of anise
Carbolic soap	Creolin

(5) *Against Actinomycosis.*

Tincture of iodine	Iodoform
Potassium iodide	Copper sulphate
Glycerite of carbolic acid	Corrosive sublimate

(6) *Against Oideum albicans.* (Thrush, aphtha, aphthous stomatitis.)

Boric acid	Alum
Potassium chlorate	Salicylic acid
Potassium Permanganate	Hydrochloric acid

(7) *Against Strongylus micrurus and filaria.* (Intratracheal injections of carbolic acid and turpentine.)

(For details concerning the use of parasiticides, see special articles on the drugs enumerated above and p. 729.)

PHARMACY.

The More Important Medicinal Bodies and Principles Contained in Drugs.

Alkaloideum, pl. *Alkaloidea,—Alkaloids.* Characteristics:

1. Alkaloids are nitrogenous bodies, being the active principles of many vegetable drugs.

2. They resemble mineral bases in that they have an alkaline reaction and unite with acids to form soluble crystalline salts. Hence their name, alkaloids.

3. Chemically they are ammonia compounds. One or more atoms of H (in NH_3) are replaced by various radicals.

4. They are mostly insoluble in water, but very soluble in alcohol. Solutions possess a bitter taste.

5. They are similar to animal alkaloids and probably have a like origin, *i.e.,* from the decomposition of albuminoid material.

6. Alkaloids are precipitated in solutions by tannin, forming insoluble tannates.

They are usually solids and their salts are soluble and convenient for hypodermic use.

8. Their Latin ending is *ina;* English, *ine;* viz.: Morphina, morphine.

Examples: An alkaloid of cinchona is quinine; of belladonna, atropine.

Glucosideum, pl. *Glucosidea.*—Glocosides are neutral, non-nitrogenous organic bodies, representing the active principles of many vegetable drugs. They yield glucose and other substances on decomposition. Hence their name. Their Latin ending is *inum;* English, *in;* viz., salcinum, salicin.

Examples: A glucoside of digitalis is digitalin; of santoninum is santonin.

Oleum, pl. *Olea.*—Fixed oils are combinations of glycerin with fatty acids; usually oleic, stearic, margaric or palmitic acids. They

are liquid at ordinary temperatures and soluble in benzin, chloroform and ether. Exposed to the air they undergo acid fermentation, resulting in "rancidity." Fixed oils are expressed from fruits and seeds of plants and animal tissue. They are "fixed" because they cannot be distilled. They leave a greasy mark on paper.

Examples: Cod liver oil, castor oil, olive oil, linseed oil and croton oil.

Oleum, pl. *Olea.*—Fats are solid, fixed oils.

Examples: Lard, cacao butter.

Oleum destillatum, pl. *Olea destillata.*—Distilled oils are obtained by the distillation of flowers, fruits, leaves or seeds of plants; by maceration, infusion, expression; or by extraction with solvents. They are either liquid or solid and possess an aromatic odor and taste. They are lighter than water, and soluble in alcohol, ether, and very slightly soluble in water. Distilled oils are miscible with fatty substances and mineral oils. They do not leave a greasy mark on paper.

Synonyms: Essential oils, volatile oils and ethereal oils. Alcoholic solutions of these oils are known as essences.

Examples: Oil of peppermint, oil of cloves, oil of wintergreen.

Oleo-resina, pl. *Oleo-resinæ.*—Oleo-resins are semi-solid mixtures of resins and volatile oils. Many are natural products, exuding from trees, as crude turpentine, which contains the volatile oil of turpentine and a resin, or what is commonly termed "rosin." They are soluble in ether.

Examples: Oleo-resin of capsicum, oleo-resin of aspidium.

Resina, pl. *Resinæ.*—Resins are brittle, amorphous solids, soluble in alcohol and alkalies. They are obtained from oleo-resins by simple distillation, as in the case of turpentine; or may be extracted from plants by means of heat or alcohol.

Examples: The resins of Burgundy pitch and podophyllum.

Balsamum, pl. *Balsama.*—Balsams are oleo-resins with the addition of either cinnamic or benzoic acids, or both. They are solids or liquids.

Examples: Balsam of Peru, balsam of Tolu.

Gummus, pl. *Gummi.**—Gums are solid exudations from plants. They are generally soluble in water, and their solutions are precipitated by alcohol.

Example: Gum acacia.

Gum Resina, pl. *Gum-Resinæ,* are solid exudations from plants consisting of a mixture of a gum and a resin.

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* Gummi (indeclinable noun), often used for gum or gums.

Pharmaceutical Processes.

Many of the technical methods are those employed in chemistry, but of those more especially used in pharmacy are the following:

PROCESSES OF MECHANICAL DIVISION.

Slicing.—This prepares the drug for further reduction, and is the first of all pharmaceutical processes.

Bruising or *Contusion.*—Consists in breaking the drug by force, and is usually performed with an iron mortar and pestle.

Rasping or *Filing.*—For those drugs not easily reduced by the former process, as guaiac wood.

Trituration.—Performed with mortar and pestle. The effect produced where there is a circular motion, accompanied by pressure.

Grinding and *Sifting.*—In order to exhaust drugs some must be ground and sifted to a finer powder than others. To accomplish this, after grinding, we use sieves of different degrees of fineness, designated by numbers 20, 40, 60, 80, 100. These have reference to the number of meshes contained to the square inch. Therefore, when a 60 powder is directed to be used, it is that which will pass through a sieve containing 60 meshes to the square inch.

Levigation.—Somewhat similar to trituration, but performed with a *slab* and *muller.* These should be made of glass, or some non-absorbent material.

Elutriation.—This consists in mixing the powder, obtained by some of the former comminuting processes, with water; agitating it; allowing the coarser particles to settle, and pouring off the supernatant liquid which holds the finer particles in suspension. The powder settles from the latter and is dried.

MECHANICAL PROCESSES.

Processes by which liquids are separated from solids, and by which active principles and soluble constituents are separated from the inert portion of the drug.

Decantation.—The process by which solids are allowed to subside in a mixture and the supernatant liquid is slowly poured off or decanted. Liquids which will not mix, or that are of different Sp. Gr., may be decanted one from the other.

Filtration.—This is the process of separating a solid insoluble

substance from a liquid by passing the liquid containing it through a porous substance called a *filter*. The filter commonly used consists of unsized or bibulous paper, although cotton, muslin, felt, earthenware, and other substances are employed.

Percolation consists in the following process: A pulverized vegetable drug (containing both soluble and insoluble constituents) is placed in a conical vessel, or *percolator,* and subjected to the action of a liquid called a *menstruum,* when the soluble portion, or *percolate,* flows from the lower opening. The menstruum as it descends becomes more and more saturated with the soluble constituents of the drug. The first that escapes is the strongest, and each successive portion of the percolate becomes weaker until the drug is exhausted. The percolate should not drop faster than one or two drops a second. Percolation is employed in making tinctures, fluid and solid extracts, syrups and some other fluid pharmaceutical preparations.

Clarification.—Is the process whereby cloudy substances are made clear by the addition of some coagulable substances, as albumin or ichthyocolla. It is the adding to any fluid, containing a sediment, a substance which will carry down all undissolved particles, then filtering or decanting the liquid.

CHEMICAL PROCESSES USED IN PHARMACY.

Solution.—The process by which soluble substances assume the fluid state through the action of a liquid.

Lixiviation.—Employed to separate a soluble constituent from an insoluble porous body. The substance to be lixiviated is mixed with water and placed in a conical vessel, the bottom of which is covered with straw or coarse sand, and, after maceration has continued sufficiently, the saturated portion, called the *lye,* is drawn off from an opening in the lower part of the vessel.

Crystallization.—Is the concentration of a liquid containing a soluble solid by means of heat, when on allowing it to stand until cool, crystals form. Stirring during cooling will produce *granulation.* Solution, filtration and crystallization are the three best ways of obtaining *pure* salts.

PROCESSES REQUIRING THE APPLICATION OF HEAT.

Liquefaction.—Is the melting of substances which at ordinary temperature are hard, and when cool return to the same condition as before heating, as resin, wax, lard, tallow.

Evaporation.—Is the conversion of a liquid into steam or vapor. Liquids which evaporate at ordinary temperature are called *volatile,* as alcohol. To keep the heat below the boiling point of water, we use the water bath, which cannot reach a higher temperature than 100° C. To gradually increase the heat, use the sand bath.

Distillation.—Is the vaporization of a liquid in a retort or a *still,* by heat, and conduction of the vapor through a cooled tube, where it is condensed and passes into a receiver and is called the *distillate.* Distillation is used to purify liquids or recover a volatile liquid from a solid, solution or mixture. Where two liquids are mixed that have different points of vaporization and are separated in this way, the process is called *rectification.*

Sublimation.—Distillation of a volatile solid. When the product is in a solid form, it is called a *sublimate,* as iodine, camphor, etc.; when in flakes, it is called *flowers,* as sulphur.

Maceration.—A term used to denote the action of liquids upon drugs at ordinary temperature.

Digestion.—Same process, with heat raised to 40° C.

Menstruum.—Any fluid substance used to dissolve a solid body or extract its medicinal principles.

Excipient.—Any substance used to give a pill mass proper consistency.

Exsiccate.—The process of removing *all* moisture, even the water of crystallization, from a crystal, by the use of heat.

Dessicate.—To remove all *excess* of moisture. Heat not usually employed in this process.

Incineration.—The combustion of a substance for its ashes.

Reduction is employed to recover a metal in its purity, when in a combined state.

Pharmaceutical Preparations.

The "United States Pharmacopœia" is an authoritative book, including the drugs of most value, with a description of their properties, tests for their purity, and methods for making their preparations. It is revised each decade by a convention of representative delegates from medical schools and societies, schools of pharmacy and pharmaceutical associations, with the collaboration of medical officers from the army, navy and Public Health Service. The last

edition dates from September 1, 1905. All matter occurring in the "Pharmacopœia" is said to be according to the U. S. P., or official. That occurring in the "British Pharmacopœia" is marked B. P.

Official Preparations.

I.—Preparations Whose Solvent is Water.

Decoctum, pl. *Decocta.*—Decoctions are solutions of crude drugs in water, obtained by boiling. Unless specified otherwise, their strength is 5 per cent., and the boiling is conducted fifteen minutes. Decoctions tend to undergo rapid decomposition, and are only suitable in case of those drugs whose active principle is soluble in water. They are unsuitable when the active principle of a drug is volatile, decomposed by heat, or when it contains much starch, which would form an easily decomposable, thick mass.

Drugs containing hard, woody substances, especially albumin, which coagulates in boiling and remains in the crude drug, are those especially adapted for this method.

Infusum, pl. *Infusa.*—Infusions are aqueous solutions of drugs made by maceration in boiling water, without the aid of ebullition. Maceration is done for half an hour, and the strength is 5 per cent., unless otherwise ordered. The same disadvantages apply in the case of infusions as with decoctions, in addition to the longer time required for their preparation. Some drugs, as digitalis or ergot, which yield their active principles to water and are more powerful when freshly made, are suitable for this process.

Liquor, pl. *Liquores.*—Solutions are preparations holding active non-volatile principles in solution in water. They have no uniform strength.

Aqua, pl. *Aquae.*—Waters are aqueous solutions of volatile principles. They have no uniform strength and are mostly solutions of volatile oils or gases.

Mistura, pl. *Misturæ.*—Mixtures are compounds consisting of a combination of fluid preparations or compounds in which solid substances are dissolved or held in suspension by an appropriate vehicle. The term is thus very comprehensive, including most prescriptions for fluids used in practice, but more narrowly it applies in pharmacy to insoluble materials suspended by suitable vehicles in water, the whole to be shaken before using. They have no uniform strength.

Emulsum, pl. *Emulsa.*—Emulsions are similar to mixtures in that an oily substance in a state of fine division is held in suspension in a gummy or albuminous vehicle. They have no uniform strength.

Syrupus, pl. *Syrupi.*—Syrups are saccharine solutions. The vehicle is usually water, although vinegar and alcohol may be used, and they are all medicated except the simple syrup. They are not of uniform strength.

II.—Preparations Whose Solvent is Alcohol.

Tinctura, pl. *Tincturæ.*—Tinctures are alcoholic solutions of non-volatile principles, made usually by maceration and percolation of the crude drug. They vary in strength; the more powerful drugs in 10 per cent., the weaker drugs in 20 per cent. solution. The alcohol in tinctures is often an important factor in the action of the preparation. Strong or diluted alcohol is used according to the solubility of the active principle.

Spiritus, pl. *Spiritus.*—Spirits are alcoholic solutions of volatile substances, either gases, liquids or solids. They have no uniform strength.

Elixir, pl. *Elixirs.*—Elixirs are alcoholic solutions of drugs containing sugar and aromatic substances.

III.—Preparations Having Wine as a Solvent.

Vinum, pl. *Vina.*—Wines are weak tinctures containing a small amount of alcohol, the remainder of the solvent being white wine. They have no definite strength.

IV.—Preparations Having as a Solvent Diluted Acetic Acid.

Acetum, pl. *Aceta.*—Vinegars are solutions of the active principles of drugs in acetic acid prepared by maceration and percolation. They are not of uniform strength.

V.—Preparations Made by Solution and Evaporation.

Extractum, pl. *Extracta.*—Extracts are concentrated preparations of the crude drug. Ordinarily alcoholic solutions of the crude

drug are obtained by maceration and percolation, and then evaporated to a pasty mass. They are usually stronger, weight for weight, than the crude drug, but are not of uniform strength.

Fluidextractum, pl. *Fluidextracta.*—Fluidextracts are permanent, concentrated medicinal solutions of uniform strength. 1 cc. of the fluidextract is equivalent to 1 gm. of the crude drug. This result is obtained by percolation (usually with alcohol) and partial evaporation.*

VI.—Preparations Made by Distillation or Occurring Naturally, as Exudations from Trees.

Oleo-Resina, pl. *Oleo-Resinæ.*—Oleo-Resins are officially extracts obtained by percolation of the crude drug with ether, and evaporation of the solvent. They have no uniform strength.

Pulvis, pl. *Pulveres.*—Powders are preparations of finely pulverized drugs. Sugar of milk is frequently added, on account of its hardness, to aid in pulverization and as a diluent. Comparatively tasteless, non-irritating and often insoluble drugs are given in this form. Drugs that are volatile, deliquescent or irritating are otherwise administered. Powders are used to advantage in veterinary practice, since they are often voluntarily on food.

Trituratio, pl. *Triturationes.*—Triturates are combinations of drugs and sugar of milk, prepared by trituration. They occur in powder or are pressed into tablets.

Oleum, pl. *Olea.*—Fixed oils are usually obtained by mechanical expression from the product of plants or the tissue of animals.

Pilula, pl. *Pilulæ.*—Pills are preparations of drugs made into globular form by the addition of a suitable excipient, and should be of a convenient size for swallowing.

Massa, pl. *Massæ.*—Masses are pasty mixtures suitable for making pills.

Suppositorium, pl. *Suppositoria.*—Suppositories are medicinal substances incorporated with cacao butter and moulded into solid, usually conical, bodies intended for introduction into the rectum or vagina, where they melt at the temperature of the body.

Confectio, pl. *Confectiones.*—Confections are pasty masses, consisting of powder incorporated with syrup.

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* The last (eighth) edition of the U. S. Pharmacopœia directs that many of the fluidextracts be assayed so that they will contain a definite prescribed amount of the active principle.

VIII.—Preparations Intended for External Use.

Linimentum, pl. *Linimenta.*—Liniments are liquid preparations with an oily, alcoholic or soapy basis.

Oleatum, pl. *Oleata.*—Oleates are medicinal solutions in oleic acid.

Unguentum, pl. *Unguenta.*—Ointments are preparations having a fatty basis (80 per cent. of lard).

Ceratum, pl. *Cerata.*—Cerates are similar to ointments but harder, owing to the addition of 10 per cent. more wax.

Glyceritum, pl. *Glycerita.*—Glycerites are preparations whose solvent is glycerin.

Emplastrum, pl. *Emplastra.*—Plasters are solid, sticky, supple preparations intended for application to the skin, where they become adhesive at the temperature of the body. In veterinary parlance they are often known as "charges."

Charta, pl. *Chartæ.*—Papers are fragments of medicated paper.

Collodium, pl. *Collodia.*—Collodions are solutions of gun cotton in ether and alcohol, leaving a thin, dry, adhesive coating when applied externally.

IX.—Preparations Having Honey as an Excipient.

Mel. pl. *Melita.*—Honeys.

X.—Non-Official Preparations Peculiar to Veterinary Practice.

Bolus, pl. *Boli.*—Balls are substitutes for pills. They are of elongated, cylindrical shape, about two and one-half inches long, and should weigh about two ounces when intended for horses. Various excipients are used to make a mass of the proper consistency. For immediate use, molasses and licorice root may be employed, and brown tissue paper is used as a covering for the balls. Gelatine capsules may take the place of the balls, and should be covered with paper to prevent slipping through the fingers when wet with saliva.

Linseed meal is a good excipient on account of its gum. Soap is often used, and glycerin makes a good preservative and keeps the mass moist.

Heat is often necessary in preparing a ball mass when the materials are resinous (as aloes) or waxy. A ball is given to a horse by holding it in the right hand, the tips of the fingers and thumb surrounding it in the form of a cone. The tongue of the animal being drawn to the operator's left with his left hand, the right is

then quickly passed along the roof of the patient's mouth (avoiding the edges of the back teeth) until the back of the tongue is reached, when the ball is dropped, the right hand rapidly removed and the tongue released.

If the mouth is narrow or the animal unmanageable, a balling iron or speculum is used to keep the mouth open. The horse may be backed into a narrow stall and the head steadied by an attendant with the assistance of a "twitch" on the nose. Substances of an irritating nature may be given in this form, and balls are also used when the disposition of the patient does not admit the giving of a drench.

Haustus, pl. *Haustus.*—A drench is an extemporaneous fluid mixture, intended for immediate use as a single dose.

Soluble substances are best given in solution to obtain the most rapid results, unless irritating. Even then they may be preferable when sufficiently diluted with water and demulcents. Insoluble drugs may at times be given to advantage in a mixture rather than in the form of a ball or powder. Most official fluid preparations require dilution before administration, but for convenience small doses of tinctures and fluidextracts are dropped upon the tongue of horses unless the preparations are exceptionally acrid. Drenches are particularly applicable for cattle and sheep, as solids are not quickly absorbed in their capacious digestive apparatus, and drenches are given them with ease.

The amount of liquid conveniently administered to horses is from one to two pints; to dogs, from two to four ounces; to sheep, six to eight ounces. Cattle take readily unlimited quantities. Care should be observed that drenches are so diluted as to be harmless to the mucous membrane, and, if containing insoluble drugs, that these be held in suspension by a suitable vehicle or thoroughly shaken before using. Drenches are best given to horses by making a loop on the end of a rope, passing the upper jaw through this, the other end of the rope being passed through a pulley in the ceiling and held by the operator or assistant. The horse should be first backed into a narrow stall. The neck of the bottle (which should properly be made of horn or tin) containing the drench, being introduced and held in the right hand of the operator between the outside of the back teeth and the inside of the cheek of the patient, the left hand is used to steady the nose of the animal, but the nostrils should not be obstructed.

In giving drenches to cattle the operator stands on their left and passes his right arm between the horns over the poll and down in front of the face, grasping the nasal septum between the thumb and forefinger. The neck of the bottle is then thrust with the left

hand into the animal's mouth. Dogs are given drenches with the aid of an assistant, who holds the mouth *closed* with one hand, while he makes a cup by pulling the corner of the lip away from the teeth with the other hand, into which the medicine may be slowly poured, the animal easily swallowing it. Small dogs may be placed sitting upon a table. A large dog may be put upon his hind quarters in a corner, and his head held between the knees of the operator. Cats are given drenches by rolling them in a heavy blanket with only the head out and the jaws held apart by means of two loops of tape about either jaw behind the incisor teeth. The jaws are then pulled apart by drawing on either loop from above and below the animal's head. Sheep may be drenched by backing them into a corner and by holding the head of the animal between the knees of the operator.

Drenches should never be poured into animals if in an unconscious condition, for then they are unable to swallow, and the fluid may gravitate into the trachea. If coughing ensues during the administration of a drench, the procedure should be immediately stopped.

A pint syringe may be used to drench the larger animals. The jaws are held closed by a strap or rope about the head and the lips held together by an attendant.

The nozzle of the syringe, or a rubber tube connected with it, is introduced at one corner of the mouth and the fluid injected toward the back of the tongue.

Electuarium, pl. *Electuaria.*—Electuaries are medicinal pastes intended to be smeared on the teeth of animals, where they melt at the temperature of the body and become absorbed. Molasses, honey, glycerin, syrup or mucilage are used as excipients. Electuaries are used for their local action on the mouth and throat, and for convenience in administration, if so crude a method may be thus described. A certain specified quantity of the electuary may be weighed by the dispenser and served as a sample, or a domestic utensil may be employed to measure the dose, which is smeared with a thin, flat stick on the back teeth or tongue of the patient.

INCOMPATIBILITY.

Before entering upon the study of prescription writing, it is essential to consider the results of improper combination of drugs, *i.e.*, incompatibility.

While a knowledge of chemistry, pharmacy and the physiological actions of drugs is necessary to avoid incompatibility, it is yet possible to formulate certain rules which will assist us in escaping unfortunate combinations.

Incompatibility is conveniently divided into three classes: I. Chemical. II. Physical. III. Physiological.

I. Chemical incompatibility occurs when drugs are so mixed that an unsuitable alteration in their chemical composition takes place. Certain substances should usually be prescribed alone because of the frequency with which chemical changes arise when they are combined with other medicines. These are:

Lead, silver and zinc salts	Mineral acids
Iodine and iodides	Solution of potassa and lime
Tannic and gallic acids	Quinine sulphate
Liquid iron preparations	Hydrocyanic acid
Corrosive sublimate	

The possibilities of the following combinations must be kept in mind to avoid incompatibility:

1. Solutions of alkaloids are incompatible with tannic acid, alkalies, alkaline salts, and iodides and bromides, because precipitation occurs.

2. Glucosides are decomposed by acids and are, therefore, incompatible with them.

3. Acids may not be added to alkalies, alkaline salts or vegetable acid salts, because decomposition and chemical change will ensue.

4. A mixture of salts in solution will decompose if either an

insoluble compound or double salt can be formed; otherwise no change will take place.

5. Chloral is incompatible with alkaline solutions, because chloroform is generated.

6. Chloroform and potassium cyanide form prussic acid.

7. Potassium chlorate, nitrate, or permanganate, liberate oxygen and should not be mixed with readily oxidizable substances, such as charcoal, sugar, sulphur, glycerin, carbolic acid, iodine, turpentine and organic materials, lest explosive compounds be formed.

8. Lime water precipitates mercury salts.

9. Both calomel and antipyrine are incompatible with sweet spirit of nitre.

10. Calomel may not be combined with nitrohydrochloric acid lest corrosive sublimate result.

11. Calomel and prussic acid form the poisonous mercuric cyanide.

12. Liquid iron compounds are incompatible with fluid preparations of the vegetable bitters (except those of calumba and quassia), because the tannic acid in them throws down a precipitate.

13. Considerable quantities of acid are incompatible with tinctures, since ethers are produced.

14. Water precipitates resinous tinctures.

15. Gum arabic is incompatible with lead and iron salts, and mineral acids.

16. Strychnine is precipitated in solution by potassium bromide.

17. Pepsin and pancreatin are mutually destructive in fluid combination.

18. Solutions of potassium chlorate and iodide unite to form a poisonous compound.

It is beyond our scope to attempt the enumeration of all possible drug-incompatibilities. The special incompatibilities of each drug may be found under the proper heading in the detailed description of them. Furthermore, we may avoid incompatibility by (above all) simplicity in prescription writing, *i.e.*, the use of a few drugs in combination. Water or alcohol are generally the best solvents.

II. Physical incompatibility consists in the production of unsightly-looking mixtures, but without necessarily causing any chemical alteration of their ingredients; for example, the addition of water to insoluble powders, oils and chloroform. While such combinations are pharmaceutically improper, they may sometimes be used to advantage in practice.

III. Physiological incompatibility consists in the union of

drugs possessing antagonistic physiological actions. For instance, the combination of purgatives and astringents; of morphine and atropine; of digitalis and nitroglycerin. Such prescriptions may be valuable therapeutically when the antagonism is not complete. This follows because, while deleterious action of one drug may be offset by another, its beneficial effect may at the same time exist or be accentuated. Thus the anodyne influence of morphine is increased by combination with atropine, but both the depressing action of morphine on the respiration and its constipating tendencies are lessened by atropine.

PRESCRIPTION WRITING.

Words and Phrases Commonly Used in Prescription Writing, With their Abbreviations.

LATIN WORD.	ABBREVIATION.	TRANSLATION.
Acidum	Acid.	An acid
Ad		To, up to
Ad libitum	Ad lib.	At pleasure
Adde	Add.	Add (thou)
Ana	A. āā.	Of each
Aqua fontana	Aq. font.	Water, spring
Aqua destillata	" dest.	" distilled
Bene		Well
Bis in dies	Bis. ind.	Twice daily
Cape, Capiat	Cap.	Take. Let him take
Capsula	Caps.	A capsule
Ceratum	Cerat.	A cerate
Charta (karta)	Chart.	A paper (medicated)
Chartula (kartula)	Chart.	A little paper for a powder
Cochleare magnum	Coch. mag.	A tablespoon
Cochleare parvum	Coch. parv.	A teaspoon
Cola, Colatus	Col.	Strain, strained
Collyrium	Collyr.	An eye wash
Compositus	Co. Comp.	Compound
Congius	C.	A gallon
Confectio	Conf.	A confection
Cortex	Cort.	Bark
Cum		With
Decoctum	Decoc.	A decoction
Dilute, Dilutus	Dil.	Dilute (thou), diluted
Divide	D. Div.	Divide (thou)
Dividendus	Dividend.	To be divided
Dividatur in parts æquales.	D. in p. æq.	Let it be divided into equal parts
Dosis	Dos.	A dose
Emplastrum	Emp.	A plaster
Enema	Enem.	An enema
Extractum	Ext.	An extract
Fac, fiat, fiant	F.	Make, let be made, let them be made
Filtrum, Filtra	Fil.	A filter. Filter (thou)
Fluidus	Fl. f.	Fluid
Glyceritum	Glyc.	A glycerin

LATIN WORD.	ABBREVIATION.	TRANSLATION.
Gutta, Guttæ	Guttat.	A drop, drops
Guttatim	Haust.	Drop by drop
Haustus	H. Hor.	A draught
Hora	Ind.	An hour
In dies	Gtt.	Daily
Infusum	Inf.	An infusion
Injectio	Inj.	An injection
Lac		Milk
Libra	Lb.	A pound, a Troy pound
Liquor, or Liq'uor	Liq.	A solution
Lotio (losheo)		A lotion
Magnus	Mag.	Large
Massa	Mass.	A pill-mass
Misce	M.	Mix
Mistura	Mist.	A mixture
Mucilago	Mucil.	A mucilage
Nox, Nocte Manequ	Parv.	Night, at night and in the morning
	Q. S. (followed by	
Numerus, Numero		A number, in number
Octarius		A pint
Pars	No.	A part (governs genitive)
Partes æquales	O.	Equal parts
Parvus		Small
Pilula	P. æ.	A pill
Pro re nata	Pil.	According to circumstances; occasionally
	P. r. n.	
Pulvis		A powder
Quantum Sufficiat	Pulv.	As much as is necessary
	genitive)	
Quaqua hora	Q. h.	Every hour
Saturatus	Sat.	Saturated
Semissis	Ss.	A half
Semidrachma	Semidr.	A half drachm
Sesuncia	Sesunc.	An ounce and a half
Signa	S. Sig.	Sign
Solve, Solutus	Solv.	Dissolve, dissolved
Solutio	Sol.	A solution
Spiritus	Spr.	A spirit
Suppositoria	Suppos.	A suppository
Syrups	Syr.	A syrup
Talis	Tal.	Such, or, like
Tinctura	Tra. Tr.	A tincture
Ter in die	T. i. d.	Three times a day
Unguentum,	Ungt.	An ointment
Vinum	Vin.	A wine
Vehiculum	Vehic.	A menstrum

A prescription, derived from the Latin *Prae,* before, and *Scriptum,* written, comes to us from the early custom of physicians in writing down their advice *beforehand* for their patients' guidance. As now used it is the written formula of the practitioner describing to the pharmacist the manner of compounding and dispensing medicines, and to the attendant the mode of administering them.

Formulæ are official when simply taken from the "United States Pharmacopœia," and extemporaneous when concocted offhand by the practitioner. Extemporaneous formulæ are simple when composed of one ingredient; a compound prescription is composed of several parts, which may be considered as follows:

I. Heading.
II. Names and quantities of drugs
III. Direction to compounder.
IV. Direction to attendant.
V. Signature of writer.

The heading, "Recipe," is derived from the Latin, the imperative of the verb meaning to take, and is ordinarily represented by the sign R, a corruption of ♃, the sign of the Zodiac for Jupiter. After the Christian era the sign of the Cross was used, or N. D., for *Nomine Deo,* in God's name; J. D. for *Juvane Deo,* meaning God helping, etc. We have now reverted to the old sign, which is all that remains of an appeal to Jupiter. This symbol seems to put the practitioner, even if involuntarily, into a position of reverence in thus offering a prayer in embryo (the old physicians also wrote one) whenever one writes a prescription. The custom also suggests that we are not yet sufficiently sure of our Materia Medica after all these centuries, to sacrifice the efficacy of prayer.

In regard to the names and quantities of drugs, we find in the text books that one should always strive after a classical arrangement, whereby four ingredients are essential to accomplish any result. These include:

I. The basis, or active medicinal substance.
II. The adjuvant, or assistant.
III. The corrigent, or corrective.
IV. The excipient, vehicle, or menstruum.

But we shall find that while such a classical arrangement may exist in the text-books, we are usually content in practice with the basis, together with a vehicle. The classical arrangement is essential in order that the old Latin motto be fulfilled: *"Curare cito, tuto*

et jucunde." *Curare*—to cure (the basis); *cito*—quickly (the adjuvant); *tuto*—safely (the corrigent); *jucunde*—pleasantly (the excipient).

In a physic ball for horses we may employ aloes as a basis; calomel as an adjuvant; ginger as a corrective; molasses as an excipient. More commonly in fluid preparations we prescribe several bases, or ingredients for curative purposes, neglecting any adjuvant or corrigent and simply using water as a vehicle. It is often of distinct advantage to write for a combination of several drugs whose action looks towards a common end. Yet one should always lean to simplicity rather than complexity in the number of ingredients. While it is difficult to avoid chemical antagonism, how much harder is it to prevent untoward physiological combinations in the body, which we can in no wise foretell. In olden times ignorance led practitioners to try the effect of an enormous number of drugs, with the hope that out of the charge one at least of the pellets in these shotgun prescriptions might strike the desired spot, if the others failed to do so. But we now believe that the damage done by all the shot which miss far surpasses the good accomplished by the successful missile. Four hundred different remedies are included in one of these old formulæ, whereas now it is rare to find four in a prescription.

In relation to the third part of the prescription (the directions to the compounder), we find that a few regulation Latin phrases or words express these directions. If one is unfamiliar with Latin, one can easily memorize these words and phrases understandingly. The directions to the attendant are heralded by the Latin *Signa*, or *Signetur*, meaning label, or let it be labelled; abbreviated, "Sig." or merely "S.," and being for the use of the attendant of the patient, are in English. The directions should be very precise. One should not write: "Use as directed," or "Give in water," but indicate exactly the quantity of medicine to be administered, the precise amount of water with which it is to be diluted, and the time at which it is to be given. For instance: "Give one tablespoonful in half a pint of water three times daily after feeding."

Poisons should be marked as such. It is well sometimes to indicate that the prescription is "for a horse," in order to avoid mistakes and to quell the qualms of the conscientious druggist.

Preparations which are not to be used internally should be labelled "external use." Under "Signature" the name of the writer and date is included. If desirable, one may inscribe "Do not repeat." Quantities used in prescription writing are indicated by the signs of the apothecaries or Troy system of weights for solids. For liquids, signs representing units of the wine measure are em-

ployed. The Troy grain and ounce are used by apothecaries as units of weights in dispensing prescriptions. In ordering large quantities (as pounds) the avoirdupois pound of 16 ounces is employed, and in buying ounces of drugs without a prescription the avoirdupois ounce is also utilized. The avoirdupois ounce contains 437 grains; the Troy ounce contains 480 grains. The grain is of similar value in both systems.

TROY, OR APOTHECARIES' WEIGHT.

Weight	*Sign*	*Latin name*
Pound	℔	Libra
Ounce	℥	Uncia
Drachm	ʒ	Drachma
Scruple	℈	Scrupulum
Grain	gr.	Granum

WINE MEASURE.

Measure	*Sign*	*Latin Name*
Gallon	C	Congius
Pint	O	Octarius
Fluid Ounce	Fl. ℥	Fluida Uncia
Fluid Drachm	Fl. ʒ	Fluida Drachma
Minim	♏	Minimum

A drop is often used synonymously with minim, which is correct if the substance spoken of is water, or a liquid of nearly similar density. If the liquid is not of similar density, then a minim, or the sixtieth part of a drachm, is far from being a drop as measured by dropping a liquid from any ordinary utensil. Any amount from 45 drops to 276 drops, measured in this way, may be obtained from a drachm of fluid, according to its density, mode of dropping, and kind of vessel from which it is dropped.

A gutta (gtt.), then, is of no fixed value, but means a drop as dropped from a vessel; while a minim is always the sixtieth part of a drachm.

RELATIVE VALUE OF UNITS IN THE WINE MEASURE.

C		O		℥		ʒ		♏
1C	=	8	=	128	=	1024	=	61,440
		Oi.	=	16	=	128	=	7,680
				℥ i.	=	8	=	480
						ʒ i.	=	60

RELATIVE VALUE OF UNITS IN TROY SYSTEM.

℔		℥		ʒ		℈		Gr.
1	=	12	=	96	=	288	=	5,760
		℥ i.	=	8	=	24	=	480
				ʒ i.	=	3	=	60
						℈ i.	=	20

The abbreviation, Fl., is usually omitted in prescription writing, as referring to fluids, the character of the preparation being sufficiently apparent. The Roman numerals are used to express the quantities employed. The Roman numerals are written under a horizontal line, the i's or j's are dotted (they are identical in Latin) and the dot serves to enforce and check the numbers used. Fractions are usually expressed in ordinary Arabic characters, except ½, which is often indicated by a double s (ss), standing for semis, the Latin for one-half.

APPROXIMATE EQUIVALENTS OF WINE UNITS IN DOMESTIC MEASURES.

Teaspoon	=	ʒ i.-ii.	=	5 Cc.
Dessert spoon	=	ʒ ii.	=	10 Cc.
Table spoon	=	℥ ss.	=	15 Cc.
Cup	=	[illegible]		120 Cc.
Tumbler	=	℥ viii.	=	250 Cc.

There are usually about six teaspoonfuls to the fluid ounce. It is a good plan to have some regard for the size of vials generally kept by druggists, and to write for a quantity to fill the bottle. The bottles commonly in use in human and canine practice are the 2 and 4 drachm; the 1, 2, 3, 4, 5, 6, 8, 12, and 16 ounce.

The 2 drachm bottles are useful for measuring the dose of fluid extracts for horses; the 3 ounce bottle is convenient in writing prescriptions in the metric system for dogs, as it holds approximately 100 Cc. The 4 ounce bottle is the common size, employed in canine practice, containing 24 doses of one teaspoonful each. The ½ pt. and pt. bottles are more appropriate for larger animals.

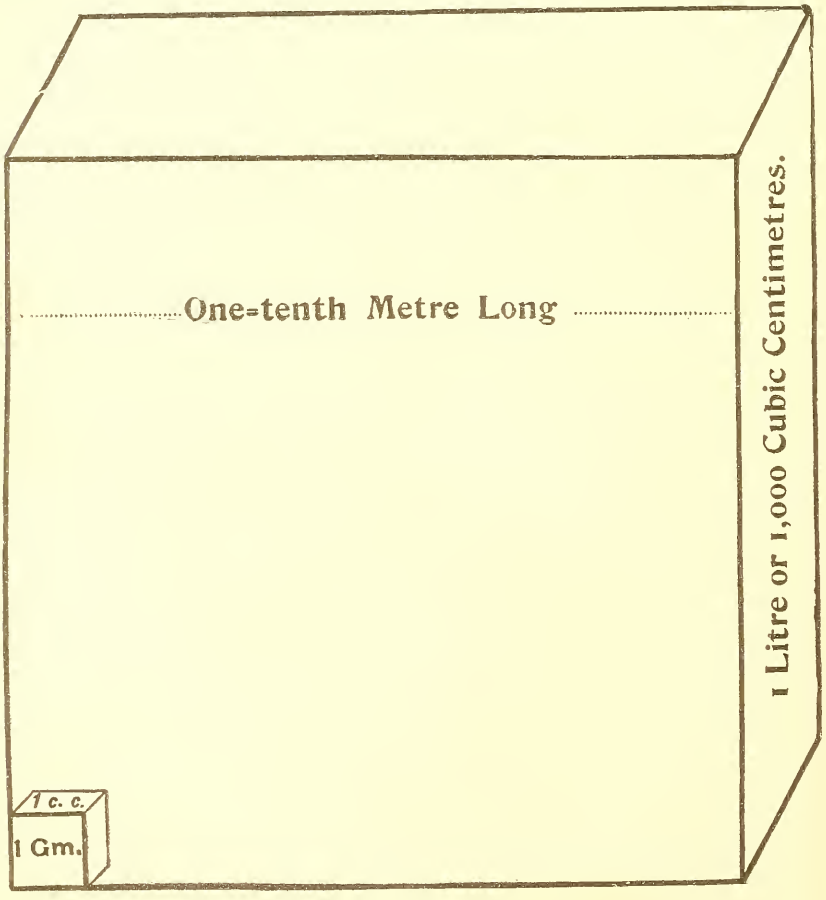
THE METRIC SYSTEM.

The metric system will be described, because it is the universal system employed in scientific writings, and is now official. It is

based on the fact that a uniform, unchangeable standard is employed as the unit of all measures, whether of weight, capacity or area. This standard is the ten-millionth part of the distance from either pole to the equator, and is denominated a meter (39.371 inches), and is the standard of length. The cube of 0.1 of a meter is taken as the unit of capacity and called a litre (2.1135 pints). The weight of water at its greatest density, 4° C. (39.2° F.), which this cube will contain, is termed a kilogram (2.2046 lbs. Avoirdupois), and is the unit of the measure of weight.

METRIC DIAGRAM.

The weight of water that the small cube will contain is one gramme. This is the unit of weight of the metric system.



But for prescriptions and other small weighings lesser units than the kilo and liter are required and therefore the cube of one-hundredth of a meter is taken and the weight of water which this cube holds is recognized as the unit of weight and called a gram (15,432 grains). The quantity of water contained in the cube of one-hundredth of a meter is used as a unit in measuring capacity in chemical and pharmaceutical practice and termed a cubic centimeter. The multiples of these measures, proceeding in decimal progression, are distinguished by Greek numerals as prefixes, *i.e.*, Deca-10, Hecto-100, Kilo-1000. The subdivisions of the unit are represented by the Latin prefixes, as Deci-0.1, Centi-0.01, Milli-0.001. Hence, using the gram as the unit, we can arrange a table as follows:

Kilogram	=	1,000 grams	=	1,000.0
Hectogram	=	100 grams	=	100.0
Decagram	=	10 grams	=	10.0
Gram	=	1 gram	=	1.0
Decigram	=	$\frac{1}{10}$ gram	=	0.1
Centigram	=	$\frac{1}{100}$ gram	=	0.01
Milligram	=	$\frac{1}{1000}$ gram	=	0.001

The metric system has the advantage of being arranged decimally, which makes the computation of percentages easy, and the transference of a quantity of one denomination to that of another, by merely shifting a decimal point. There are other advantages which make it of value to practitioners. Our present system is not uniform with that of any other country. The English, while using the same nomenclature for weights and measures, put a different value upon them. The system has another value, at least theoretically, in having one unit for weights and measures. The unit of the fluid measure is 1 cubic centimeter of water, which at 4° C. weighs one gram. As a matter of fact, fluids are dispensed in the metric system by measuring them in Cc., and if liquids were all of the same density as water, they would be equivalent to grams of water when measured in Cc. Unfortunately, this is not the case. Theoretically, medicine should be dispensed by weight in the metric system, but as medicines, when given to patients, are usually measured by bulk, they cannot be dispensed by weight without producing a complication. For example, suppose that we order chloroform in a prescription in the metric system,—

℞ Chloroformi 30 |

S. Two teaspoonfuls in water.

JOHN SMITH.

thinking we are dispensing 10 grams,* for a teaspoonful holds 5 grams of water. But as chloroform weighs ½ more than water, we really have ordered 10+½=15 Gm. of chloroform. Therefore, in writing a prescription for chloroform with other ingredients, weighed in Gm., we would have to add ½ of the number of Gm. of chloroform in the prescription to the number previously estimated in order to make the chloroform of the same bulk as other liquids of the density of water.

In order to avoid reducing substances of density differing from that of water, to terms of equivalency with that of water, it is the custom, and now official, to weigh solids in Gm. and measure liquids in Cc. This is an exact method if the doses of drugs are learned in the same way: *i.e.*, if the doses of solids are learned in Gm. and prescribed in Gm., and the doses of liquids are learned in Cc. and prescribed in Cc.

In writing prescriptions in the metric system a line is drawn perpendicularly across the right-hand side of the blank to indicate the decimal point; multiples of the unit being placed to the left of the line, while fractions are written to the right of the decimal line. In using this system we are spared the annoyance of special signs and different tables for weights and measures. As matters now stand we must be cognizant of both systems, and be able to convert the old into the new, or *vice versa*. One drachm is equivalent to four grams, 3 i.=Gm. 4. Therefore, Gm. 1=3¼ or Gr. 15. Then Gr. i.=1/15 of Gm. i.; or

15) 1.000 (.066
90

100
90

The equivalent of Gr. 1 is Gm. .06. In order to determine the equivalent of fractions of a grain in grams, we divide .06 by the denominator and multiply the result by the numerator of the fraction of a grain. For example:

Gr. ⅔ = ⅔ of .06 Gm.; as .06 Gm. = Gr. i., then
3) .06 (.02 × 2 = .04. Therefore, Gr. ⅔ = .04 Gm.
6

0

* For each dose.

Again: to find the equivalent of Gr. $\frac{1}{8}$ in Gm.

$$8).066(.008 \times 1 = .008$$
$$64$$
$$2$$

Therefore, Gr. $\frac{1}{8} = .008$ Gm.

We stated that ʒ i.=4 Gm. It follows that ℥ i. would equal 32 Gm. As a fact, ʒ i. apothecaries' weight, is equivalent to a trifle less than Gm. 4.; and an ounce, apothecaries' weight, is usually considered equal to 30 Gm. (exactly 31.10 Gm.) for the sake of convenience. A fluid ounce in wine measure is precisely equivalent to 29.57 Cc. We have here another reason why both solid and fluid ounces should be valued at 30 Gm. or Cc. Although it is the custom to regard the minim of liquid as the equivalent of one grain, it is inexact. An apothecaries' ounce weighs 480 Gr.; a fluid ounce of wine measure weighs 457 Gr. Multiples of grams or cubic centimeters may be designated as such, instead of using the technical terms. It is perfectly proper to speak of 100 Gm. as one hundred grams, although technically equal to a hectogram. .1 Gm. may be called one-tenth gram, although technically a decigram. Similar remarks apply to Cc., yet 1,000 Cc. (approximately 1 quart) equal one liter, and this term is in common use.

TABLE FOR CONVERTING APOTHECARIES' WEIGHTS AND MEASURES INTO GRAMS AND CUBIC CENTIMETERS.

FLUIDS.		SOLIDS.	
Troy Weight.	Metric.	Apothecaries' Measure.	Metric.
Grains.	Grams.	Minims.	Cc.
1/64	.001	1	.06
1/40	.0015	2	.12
1/30	.002	3	.18
1/20	.003	4	.24
1/16	.004	5	.30
1/12	.005	6	.36
1/10	.006	7	.50
1/8	.008	8	.42
1/6	.010	9	.55
1/4	.016	10	.60
1/3	.02	15	.72
1/2	.03	16	1.00
1	.065	20	1.25
2	.13	25	1.55
3	.20	30	1.90
4	.26	35	2.20
5	.32	40	2.50
6	.39	48	3.00
8	.52	50	3.12
10	.65	60 (f. ʒ i.)	3.75
15	1.00	72	4.50
20 (ʒ i.)	1.30	80	5.00
24	1.50	90	5.60
26	1.62	96	6.00
30	1.95	100	6.25
40	2.60	120	7.50
50	3.20	160	10.00
60 (ʒ i.)	3.90	180	11.25
120 (ʒ ii.)	7.80	240 (f. ℥ ss.)	15.00
180	11.65	f ʒ v.	18.75
240	15.50	f ʒvi.	22.50
300	19.40	f ʒvii.	26.25
360	23.30	f ℥ i.	30.00
420	27.20	f ℥ ii.	60.00
480	31.10	f ℥ iii.	90.00
℥ ii.	62.20	f ℥ iv.	120.00
℥ iv.	124.40	f ℥ v.	150.00
℥ vi.	186.60	f ℥ vi.	180.00
℥ viii.	248.80	f ℥ viii.	240.00

METRIC WEIGHTS.	EXACT EQUIVALENT IN GRAINS.	APPROXIMATE EQUIVALENTS IN GRAINS.
.001	.0154	1/65
.002	.0308	1/32
.003	.0463	1/22
.004	.0617	1/16
.005	.0771	1/13
.006	.0926	1/11
.007	.1080	1/9
.008	.1234	1/8
.009	.1389	1/7
.01	.1543	1/6
.02	.3086	1/3
.03	.4630	6/13
.04	.6173	7/11
.05	.7717	3/4
.06	.9260	9/10
.07	1.0803	1
.08	1.2347	1¼
.09	1.3890	1⅓
.10	1.543	1½
.20	3.086	3
.30	4.630	4½
.40	6.173	6
.50	7.717	7½
.60	9.260	9
.70	10.803	11
.80	12.347	12½
.90	13.890	14
1.00	15.432	15
2.00	30.864	ʒ ss.
3.00	46.296	℈ ii.
4.00	61.728	ʒ i.
5.00	77.160	℈ iv
6.00	92.592	ʒ iss
7.00	108.024	℈ vss
8.00	123.456	ȝ ii.
9.00	138.888	℈ vii.
10.00	154.320	ʒ iiss.

Rules for Forming the Genitive Case in Prescription Writing.

The Latin names of drugs, as we learn them, when consisting of a single word, are in the nominative case. For example: *oleum,* an oil. The genitive case of a Latin word means of (the word), and is equivalent to the English possessive. Thus the Latin name *Oleum Lini,* consists of two words. The first, *oleum,* is the Latin nominative for oil, and the second word, *lini,* is the Latin genitive of the word meaning linseed. The name signifies, then, *oleum* (oil) and *lini* (of linseed). In writing prescriptions it is usually essential to put the Latin name of the drug in the genitive case, following the use of the heading R, standing for the Latin imperative *Recipe,* meaning in English, Take.

For example:

℞
Potassii nitratis .....ʒ i.

Literally translated this means:

Take
Of potassium nitrate, ounce 1.

There is only one other case which is used in writing prescriptions (the accusative), but this can be avoided by using abbreviations in the few instances in which it should be employed. The following rules can be memorized (with their exceptions) in order to form the genitive case (singular):

(1) Latin names of drugs ending in "*a*" form their genitive in ae. The only exceptions are three: Physostigma takes the genitive in *tis, physostigmatis. Folia* (leaves), pl. genitive, *foliorum. Theobroma,* genitive *theobromatis.* In most instances the genitive of Latin nouns ending in *a,* can be made in practice by dropping the nominative ending (*a*) and adding æ in its place, viz.: *Tinctur-a* (a tincture), genitive *tinctur-ae* (of a tincture).

(2) All pharmacopœial nouns ending in *us, um* (*os* and *on*), form their genitive in *i.* This genitive case can be formed in practice by dropping the nominative ending (*us* or *um*) and adding *i* in its place, viz.: *bol-us,* a ball; genitive *bol-i,* of a ball. *Extract-um,* an extract; genitive *extract-i,* of an extract.

The nouns ending in *os* and *on* are very few. Exceptions: *Rhus,* genitive *rhois. Flos,* genitive *floris. Fructus, quercus* and

spiritus do not change in the genitive, as it is the same as the nominative case.

(3) All other Latin names of drugs, of whatever termination (except those ending as described under rules 1 and 2) have their genitive in *s* and *is*.

The genitive case can be formed in practice, in some instances, by adding *is* to the nominative, as, for example, choral, genitive choral-is; æther, genitive æther-is. To many nouns ending in the nominative in *as* or *is*, we not only add *is* to the nominative, but also change the latter letter of the nominative case. For instance, to sulphas (sulphate) not only do we add *is*, sulphas-is, but we change the latter letter, *s*, of sulphas into a *t*, so that the proper genitive of sulphas is sulphat-is.

The same remark applies to all the other Latin names of salts, as sulphis, genitive sulphit-is; nitras, genitive nitrat-is; hydrochloras, genitive hydrochlorat-is; citras, genitive citrat-is; phosphas, genitive phosphat-is; acetas, genitive acetat-is. Cortex is not cortex-is in the genitive, but corticis. Mas, genitive not mas-is, but maris. Adeps, genitive not adeps-is, but adipis. Mucilago, pepo and pulvis lengthen and change in the gentive to mucilagin-is, pepon-is and pulver-is. Aloe, genitive not aloeis, but aloës, adding *s* and not *is*.

(4) Some Latin names of drugs do not change their ending in the genitive because indeclinable and not latinized, or else they belong to the fourth declension, where the genitive case is the same as the nominative. Examples: Spiritus, quercus and fructus, already mentioned, as exceptions to rule 2. Cannabis, digitalis, sinapis and hydrastis. The genitive of these nouns is the same as the nominative.

The following are indeclinable: Amyl, buchu, catechu, coca, curare, jaborandi, kino, phenol, salol, naphtol, thymol, menthol, cusso, gummi, etc.

If the Latin names for quantities and amounts thereof are written out in full (instead of using signs for quantities, and numbers for the amounts), the quantities and amounts in Latin must be put into the accusative case, as they are the objects of the verb, *recipe*.

For example:

℞

Sodii Sulphatis, uncias duas.

Translated:

Take

Of sodium sulphate, ounces two.

The Latin noun *uncia* (ounce) is in the accusative case, and the adjective *duas* is also in the accusative, agreeing with *uncias*. But to write out prescriptions in full, as above, is not customary and would be considered pedantic.

Again: The Latin names of the ingredients should be written in the accusative case when no noun for weight or measure is employed. For example:

℞

Pilulas catharticas compositas duas.

Translated literally:

Take

Pills cathartic compound, two. Or, take two compound cathartic pills.

Pilulas (pills) is in the accusative object of the verb recipe. Catharticas, compositas, and duas are adjectives, agreeing with pilulas. We can only write this prescription correctly, without using the accusative case, by abbreviating it as follows:

℞

Pil. Cath. Co. ii.

List of Latin Nouns With Their Genitive Endings Found in the Pharmacopœia.*

[The figure in parenthesis after each word indicates the declension to which it belongs.]

Acacia,	Acaciæ (1).
Acetanilidum,	Acetanilidi (2).
Acetas,	Acetatis (3).
Aceticum,	Acetici (2).
Acetonum,	Acetoni (2).
Acetphenetidinum,	Acetphenetidini (2).
Acetum,	Aceti (2).
Acidum,	Acidi (2).
Aconitina,	Aconitinæ (1).
Aconitum,	Aconitii (2).
Adeps,	Adipis (3).
Adhesivum,	Adhesivi (2).
Adjuvans,	Adjuvantis (3).
Æther,	Ætheris (3).
Alcohol,	Alcoholis (3).
Aloe,	Aloes (3).
Aloinum,	Aloini (2).
Althæa,	Althææ (1).
Alumen,	Aluminis (3).
Aluminum,	Alumini (2).
Ammonia,	Ammoniæ (1).
Ammonium,	Ammonii (2).
Amygdala,	Amygdalæ (1).
Amyl,	Amylis (3).
Amylum,	Amyli (2).
Animal,	Animalis (3).
Anisum,	Anisi (2).
Anthemis,	Anthemidis (3).
Antidiphtheriticum,	Antidiphtheritici (2).
Antimonium,	Antimonii (2).
Antipyrina,	Antipyrinæ (1).
Antisepticus,	Antiseptici (2).
Apocynum,	Apocyni (2).
Apomorphina,	Apomorphinæ (1).
Aqua,	Aquæ (1).
Argentum,	Arnicæ (1).
Arnica,	Argenti (2).
Arsenas,	Arsenatis (3).
Arsenosum,	Arsenosi (2).
Arsenum,	Arseni (2).
Asafœtida,	Asafœtidæ (1).
Aspidium,	Aspidii (2).
Atropina,	Atropinæ (1).
Aurantium,	Aurantii (2).
Aurum,	Auri (2).
Balsamum,	Balsami (2).
Belladonna,	Belladonnæ (1).
Benzaldehydum,	Benzaldehydi (2).
Benzinum,	Benzini (2).
Benzoas,	Benzoatis (3).
Benzoicum,	Benzoici (2).
Benzoinum,	Benzoini (2).
Benzosulphinidum,	Benzosulphinidi (2).
Berberis,	Berberidis (3).
Betanaphthol,	Betanaphtholis (3).
Bicarbonas,	Bicarbonatis (3).
Bismuthum,	Bismuthi (2).
Bisulphis,	Bisulphitis (3).
Bitartras,	Bitartratis (3).
Boras,	Boratis (3).
Bos,	Bovis (3).
Bromidum,	Bromidi (2).
Bromoformum,	Bromoformi (2).
Boricum,	Borici (2).
Bromum,	Bromi (2).
Buchu (indeclinable).	
Caffeina,	Caffeinæ (1).
Calamus,	Calami (2).
Calcium,	Calcii (2).
Calendula,	Calendulæ (1).
Calumba,	Calumbæ (1).
Calx,	Calcis (3).
Cambogia,	Cambogiæ (1).
Camphora,	Camphoræ (1).
Camphoras,	Camphoratis (3).

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Camphoricum,	Camphorici (2).
Canadensis,	Canadensis (3).
Cannabis,	Cannabis (3).
Cantharis,	Cantharidis (3).
Capsicum,	Capsici (2).
Carbo,	Carbonis (3).
Carbonas,	Carbonatis (3).
Carbonei (neuter genitive used as substantive).	
Cardamomum,	Cardamomi (2).
Carum,	Cari (2).
Caryophyllus,	Caryophylli (2).
Cassia,	Cassiæ (1).
Cataplasma,	Cataplasmatis (3).
Cera,	Ceræ (1).
Ceratum,	Cerati (2).
Cerium,	Cerii (2).
Cetaceum,	Cetacei (2).
Charta,	Chartæ (1).
Chimaphila,	Chimaphilæ (1).
Chirata,	Chiratæ (1).
Chloralformamidum,	Chloralformamidi (2).
Chloralum,	Chlorali (2).
Chloras,	Chloratis (3).
Chloridum,	Chloridi (2).
Chlorinata,	Chlorinatæ (1).
Chloroformum,	Chloroformi (2).
Chondrus,	Chondri (2).
Chromium,	Chromii (2).
Chrysarobinum,	Chrysarobini (2).
Cimicifuga,	Cimicifugæ (1).
Cinchona,	Cinchonæ (1).
Cinchonidina,	Cinchonidinæ (1).
Cinchonina,	Cinchoninæ (1).
Cinnaldehydum,	Cinnaldehydi (2).
Cinnamomum,	Cinnamomi (2).
Citras,	Citratis (3).
Citricum,	Citrici (2).
Coca,	Cocæ (1).
Cocaina,	Cocainæ (1).
Coccus,	Cocci (2).
Codeina,	Codeinæ (1).
Colchicina,	Colchicinæ (1).
Colchicum,	Colchici (2).
Collodium,	Collodii (2).
Colocynthis,	Colocynthidis (3).
Confectio,	Confectionis (3).
Conium,	Conii (2).
Convallaria,	Convallariæ (1).
Copaiba,	Copaibæ (1).
Coriandrum,	Coriandri (2).
Cormus,	Cormi (2).
Cortex,	Corticis (3).
Creosotum,	Creosoti (2).
Cresol,	Cresolis (3).
Creta,	Cretæ (1).
Cubeba,	Cubebæ (1).
Cuprum,	Cupri (2).
Cusso (indeclinable).	
Cyanidum,	Cyanidi (2).
Cypripedium,	Cypripedii (2).
Decocta,	Decoctæ (1).
Dichromas,	Dichromatis (3).
Digitalis,	Digitalis (3).
Disulphidum,	Disulphidi (2).
Elastica,	Elasticæ (1).
Elaterinum,	Elaterini (2).
Elixir (indeclinable).	
Emplastrum,	Emplastri (2).
Emulsum,	Emulsi (2).
Ergota,	Ergotæ (1).
Eriodictyon,	Eriodictyontis (3). Eriodictyi (Pharmacopœia).
Eucalyptol,	Eucalyptolis (3).
Eucalyptus,	Eucalypti (2).
Eugenol,	Eugenolis (3).
Euonymus,	Euonymi (2).
Eupatorium,	Eupatorii (2).
Extractum,	Extracti (2).
Fel,	Fellis (3).
Ferrocyanidum,	Ferrocyanidi (2).
Ferrum,	Ferri (2).
Ficus,	Fici (2), also ficus, ficus.
Fistula,	Fistulæ (1).
Fluidextractum,	Fluidextracti (2).
Fœniculum,	Fœniculi (2).
Folium,	Folii (2).
Formaldehydum,	Formaldehydi (2).
Frangula,	Frangulæ (1).
Galla,	Gallæ (1).
Gallas,	Gallatis (3).
Gallicum,	Gallici (2).
Gambir (indeclinable).	

Gelatinum,	Gelatini (2).
Gelsemium,	Gelsemii (2).
Gentiana,	Gentianæ (1).
Geranium,	Geranii (2).
Glandula,	Glandulæ (1).
Glandulæ,	Glandularum (1) plural.
Glycerinum,	Glycerini (2).
Glyceritum,	Glyceriti (2).
Glycyrrhiza,	Glycyrrhizæ (1).
Glycyrrhizinum,	Glycyrrhizini (2).
Gossypium,	Gossypii (2).
Granatum,	Granati (2).
Grindelia,	Grindeliæ (1).
Guaiacol,	Guaiacolis (3).
Guaiacum,	Guaiaci (2).
Guarana,	Guaranæ (1).
Hæmatoxylon,	Hæmatoxyli (2).
Hammamelis,	Hammamelidis (3).
Hedeoma,	Hedeomæ (1).
Hexamethylenamina,	Hexamethyl enaminæ (1).
Homatropina,	Homatropinæ (1).
Humulus,	Humuli (2).
Hydrargyrum,	Hydrargyri (2).
Hydrastina,	Hydrastinæ (1).
Hydrastis,	Hydrastis (3).
Hydriodicum,	Hydriodici (2).
Hydrobromicum,	Hydrobromici (2).
Hydrobromidum,	Hydrobromidi (2).
Hydrochloricum,	Hydrochlorici (2).
Hydrochloridum,	Hydrochloridi (2).
Hydrocyanicum,	Hydrocyanici (2).
Hydroxidum,	Hydroxidi (2).
Hyoscina,	Hyoscinæ (1).
Hyoscyamina,	Hyoscyaminæ (1).
Hyoscyamus,	Hyoscyami (2).
Hypophosphas,	Hypophosphatis (3).
Hypophosphis,	Hypophosphitis (3).
Hypophosphorosum,	Hypophosphorosi (2).
Indica,	Indicæ (1).
Infusum,	Infusi (2).
Iodidum,	Iodidi (2).
Iodoformum,	Iodoformi (2).
Iodolum,	Iodoli (2).
Iodum,	Iodi (2).
Ipecacuanha,	Ipecacuanhæ (1).
Jalapa,	Jalapæ (1).
Kaolinum,	Kaolini (2).
Kino (indeclinable).	
Krameria,	Krameriæ (1).
Lac,	Lactis (3).
Lactas,	Lactatis (3).
Lacticum,	Lactici (2).
Lactucarium,	Lactucarii (2).
Lappa,	Lappæ (1).
Laptandra,	Laptandræ (1).
Lignum,	Ligni (2).
Limo,	Limonis (3).
Linimentum,	Linimenti (2).
Linum,	Lini (2).
Liquor,	Liquoris (3).
Lithium,	Lithii (2).
Lobelia,	Lobeliæ (1).
Lupulinum,	Lupulini (2).
Lycopodium,	Lycopodii (2).
Magnesium,	Magnesii (2).
Maltum,	Malti (2).
Manganum,	Mangani (2).
Manna,	Mannæ (1).
Marrubium,	Marrubii (2).
Massa,	Massæ (1).
Mastiche,	Masticheş (1) Greek noun.
Matico (indeclinable).	
Matricaria,	Matricariæ (1).
Medulla,	Medullæ (1).
Mel,	Mellis (3).
Mentha,	Menthæ (1).
Menthol,	Mentholis (3).
Methyl,	Methylis (3).
Methylthionina,	Methylthioninæ (1).
Mezereum,	Mezerii (2).
Mistura,	Misturæ (1).
Morphina,	Morphinæ (1).
Morrhua,	Morrhuæ (1).
Moschus,	Moschi (2).
Mucilago,	Mucilaginis (3).
Myristica,	Myristicæ (1).
Myrrha,	Myrrhæ (1).

Naphthalenum,	Naphthaleni (2).
Nitras,	Nitratis (3).
Nitricum,	Nitrici (2).
Nitris,	Nitritis (3).
Nitrohydrochloricum,	Nitrohydrochlorici (2).
Nux vomica,	Nucis Vomicæ (3 and 1).
Oleas,	Oleatis (3).
Oleatum,	Oleati (2).
Oleicum,	Oleici (2).
Oleoresina,	Oleoresinæ (1).
Oleum,	Olei (2).
Opium,	Opii (2).
Opulus,	Opuli (3).
Oxalas,	Oxalatis (3).
Pancreatinum,	Pancreatini (2).
Paraffinum,	Paraffini (2).
Paraldehydum,	Paraldehydi (2).
Pareira,	Pareiræ (1).
Pelletierina,	Pelletierinæ (1).
Pepo,	Peponis (3).
Pepsinum,	Pepsini (2).
Permanganas,	Permanganatis (3).
Petrolatum,	Petrolati (2).
Phenol,	Phenolis (3).
Phenol sulphonas,	Phenol sulphonatis (3).
Phenyl,	Phenylis (3).
Phosphas,	Phosphatis (3).
Phosphis,	Phosphitis (3).
Phosphoricum,	Phosphorici (2).
Phosphorus,	Phosphori (2).
Physostigma,	Physostigmatis (3).
Phytolacca,	Phytolaccæ (1).
Pilocarpina,	Pilocarpinæ (1).
Pilocarpus,	Pilocarpi (2).
Pilula,	Pilulæ (1).
Pilulæ,	Pilularum (1) plural.
Pimenta,	Pimentæ (1).
Piper,	Piperis (3).
Piperina,	Piperinæ (1).
Pix,	Picis (3).
Plumbum,	Plumbi (2).
Podophyllum,	Podophylli (2).
Potassium,	Potassii (2).
Prunifolium,	Prunifolii (2).
Prunum,	Pruni (2).
Prunus,	Pruni (2).
Pulvis,	Pulveris (3).
Purshiana,	Purshianæ (1).
Pyrethrum,	Pyrethri (2).
Pyrogallol,	Pyrogallolis (3).
Pyrophosphas,	Pyrophosphatis (3).
Pyroxylinum,	Pyroxilini (2).
Quassia,	Quassiæ (1).
Quercus,	Quercus (4).
Quillaja,	Quillajæ (1).
Quinina,	Quininæ (1).
Radix,	Radicis (3).
Resina,	Resinæ (1).
Resorcinol,	Resorcinolis (3).
Rhamnus,	Rhamni (2).
Rheum,	Rhei (2).
Rheus,	Rhois (3) Greek noun.
Rosa,	Rosæ (1).
Rubus,	Rubi (2).
Sabal,	Sabalis (3).
Sabina,	Sabinæ (1).
Saccharum,	Sacchari (2).
Safrolum,	Safroli (2).
Salicinum,	Salicini (2).
Salicylas,	Salicylatis (3).
Salicylicum,	Salicylici (2).
Salvia,	Salviæ (1).
Sanguinaria,	Sanguinariæ (1).
Santalum,	Santali (2).
Santonica,	Santonicæ (1).
Santoninum,	Santonini (2).
Sapo,	Saponis (3).
Sarsaparilla,	Sarsaparillæ (1).
Sassafras (indeclinable).	
Scammonium,	Scammonii (2).
Scilla,	Scillæ (1).
Scoparius,	Scoparii (2).
Scopola,	Scopolæ (1).
Scopolamina,	Scopolaminæ (1).
Scutellaria,	Scutellariæ (1).
Semen,	Seminis (3).
Senega,	Senegæ (1).
Senna,	Sennæ (1).

Serpentaria,	Serpentariæ (1).
Serum,	Seri (2).
Sevum,	Sevi (2).
Sinapis,	Sinapis (3).
Sodium,	Sodii (2).
Sparteina,	Sparteinæ (1).
Spigelia,	Spigeliæ (1).
Spiritus,	Spiritus (4).
Staphisagria,	Staphisagriæ (1).
Stearas,	Stearatis (3).
Stearicum,	Stearici (2).
Stillingia,	Stillingiæ (1).
Stramonium,	Stramonii (2).
Strontium,	Strontii (2).
Strophanthinum,	Strophanthini (2).
Strophanthus,	Strophanthi (2).
Strychnina,	Strychninæ (1).
Styrax,	Styracis (3).
Subacetas,	Subacetatis (3).
Subcarbonas,	Subcarbonatis (3).
Subgallas,	Subgallatis (3).
Subnitras,	Subnitratis (3).
Subsalicylas,	Subsalicylatis (3).
Subsulphas,	Subsulphatis (3).
Succus,	Succi (2).
Sulphas,	Sulphatis (3).
Sulphis,	Sulphitis (3).
Sulphonethylmethanum,	Sulphonethylmethani (2).
Sulphonmethanum,	Sulphonmethani (2).
Sulphur,	Sulphuris (3).
Sulphuricum,	Sulphurici (2).
Sulphurosum,	Sulphurosi (2).
Sumbul (indeclinable).	
Suppositoria,	Suppositoriæ (1).
Suprarenales,	Suprarenalium (3) plural.
Syrupus,	Syrupi (2).
Talcum,	Talci (2).
Tamarindus,	Tamarindi (2).
Tannas,	Tannatis (3).
Tannicum,	Tannici (2).
Taraxacum,	Taraxaci (2).
Tartaricum,	Tartarici (2).
Tartras,	Tartratis (3).
Terebenum,	Terebeni (2).
Terebinthina,	Terebinthinæ (1).
Terpinum,	Terpini (2).
Tersulphas,	Tersulphatis (3).
Theobroma,	Theobromatis (3).
Thiosulphas,	Thiosulphatis (3).
Thymol,	Thymolis (3).
Thyroideæ,	Thyroidearum (1) plural.
Tinctura,	Tincturæ (1).
Tragacantha,	Tragacanthæ (1).
Trichloraceticum,	Trichloracetici (2).
Trioxidum,	Trioxidi (2).
Triticum,	Tritici (2).
Trituratio,	Triturationis (3).
Trochiscus,	Trochisci (2).
Ulmus,	Ulmi (2).
Unguentum,	Unguenti (2).
Uva ursi,	Uvæ ursi (1).
Valeriana,	Valerianæ (1).
Vanilla,	Vanillæ (1).
Vanillinum,	Vanillini (2).
Veratrina,	Veratrinæ (1).
Veratrum,	Veratri (2).
Viburnum,	Viburni (2).
Vinum,	Vini (2).
Virginiana,	Virginianæ (1).
Xanthoxylum,	Xanthoxyli (2).
Zea,	Zeæ (1).
Zincum,	Zinci (2).
Zingiber,	Zingiberis (3).

List of Latin Adjectives Found in the Pharmacopœia, With Their Genitive Endings.

	Masculine.	Feminine.	Neuter.
Nom.	Albus,	Alba,	Album.
Gen.	Albi,	Albæ,	Albi.
Nom.	Amarus,	Amara,	Amarum.
Gen.	Amari,	Amaræ,	Amari.
Nom.	Ammoniatus,	Ammoniata,	Ammoniatum.
Gen.	Ammoniati,	Ammoniatæ,	Ammoniati.
Nom.	Aromaticus,	Aromatica,	Aromaticum.
Gen.	Aromatici,	Aromaticæ,	Aromatici.
Nom.	Cantharidatus,	Cantharidata,	Cantharidatum.
Gen.	Cantharidati,	Cantharidatæ,	Cantharidati.
Nom	Compositus,	Composita,	Compositum.
Gen.	Compositi,	Compositæ,	Compositi.
Nom.	Corrosivus,	Corrosiva,	Corrosivum.
Gen.	Corrosivi,	Corrosivæ,	Corrosivi.
Nom.	Depuratus,	Depurata,	Depuratum.
Gen.	Depurati,	Depuratæ,	Depurati.
Nom.	Dilutus,	Diluta,	Dilutum.
Gen.	Diluti,	Dilutæ,	Diluti.

	Masculine and Feminine.	
Nom.	Effervescens,	Effervescens.
Gen.	Effervescentis,	Effervescentis.

	Masculine.	Feminine.	Neuter.
Nom.	Exsiccatus,	Exsiccata,	Exsiccatum.
Gen.	Exsiccati,	Exsiccatæ,	Exsiccati.
Nom.	Flavus,	Flava,	Flavum.
Gen.	Flavi,	Flavæ,	Flavi.

	Masculine and Feminine.	
Nom.	Flexilis,	Flexile.
Gen.	Flexilis,	Flexilis.
Nom.	Glacialis,	Glaciale.
Gen.	Glacialis,	Glacialis.

	Masculine.	Feminine.	Neuter.
Nom.	Glycerinatus,	Glycerinata,	Glycerinatum.
Gen.	Glycerinati,	Glycerinatæ,	Glycerinati.
Nom.	Granulatus,	Granulata,	Granulatum.
Gen.	Granulati,	Granulatæ,	Granulati.
Nom.	Hydratus,	Hydrata,	Hydratum.
Gen.	Hydrati.	Hydratæ.	Hydrati.
Nom.	Liquefactus,	Liquefacta,	Liquefactum.

	Masculine.	Feminine.	Neuter.
Gen.	Liquefacti,	Liquefactæ,	Liquefacti.
Nom.	Liquidus,	Liquida,	Liquidum.
Gen.	Liquidi,	Liquidæ,	Liquidi.
Nom.	Lotus,	Lota,	Lotum.
Gen.	Loti,	Lotæ,	Loti.

	Masculine and Feminine.	
Nom.	Mitis,	Mite.
Gen.	Mitis,	Mitis.
Nom.	Mollis,	Molle.
Gen.	Mollis,	Mollis.

	Masculine.	Feminine.	Neuter.
Nom.	Niger,	Nigra,	Nigrum.
Gen.	Nigri,	Nigræ,	Nigri.
Nom.	Piperatus,	Piperata,	Piperatum.
Gen.	Piperati,	Piperatæ,	Piperati.
Nom.	Ponderosus,	Ponderosa,	Ponderosum.
Gen.	Ponderosi,	Ponderosæ,	Ponderosi.
Nom.	Præcipitatus,	Præcipitata,	Præcipitatum.
Gen.	Præcipitati,	Præcipitatæ.	Præcipitati.
Nom.	Præparatus,	Præparata,	Præparatum.
Gen.	Præparati,	Præparatæ,	Præparati.
Nom.	Purificatus,	Purificata,	Purificatum.
Gen.	Purificati,	Purificatæ,	Purificati.
Nom.	Reductus,	Reducta,	Reductum.
Gen.	Reducti,	Reductæ,	Reducti.
Nom.	Ruber,	Rubra,	Rubrum.
Gen.	Rubri,	Rubræ,	Rubri.
Nom.	Saccharatus,	Saccharata,	Saccharatum.
Gen.	Saccharati,	Saccharatæ,	Saccharati.
Nom.	Siccus,	Sicca,	Siccum.
Gen.	Sicci,	Siccæ,	Sicci.
Nom.	Sicci,	Siccæ,	Sicca. } plural.
Gen.	Siccorum,	Siccarum,	Siccorum. } plural.

	Masculine and Feminine.	
Nom.	Solubilis.	Solubile.
Gen.	Solubilis,	Solubilis.

	Masculine.	Feminine.	Neuter.
Nom.	Stypticus,	Styptica,	Stypticum.
Gen.	Styptici,	Stypticæ,	Styptici.
Nom.	Sublimatus,	Sublimata,	Sublimatum.
Gen.	Sublimati,	Sublimatæ,	Sublimati.

Examples of Prescriptions for Different Preparations.

TO WRITE A PRESCRIPTION FOR A PILL.

1. We calculate the number of pills we wish to prescribe and then multiply the dose of each ingredient in the pill by that number. We will suppose that we desire to prescribe 30 pills to a dog, containing reduced iron, socotrine aloes and sulphate of strychnine. The dose of reduced iron is gr.ii.; of socotrine aloes gr.ss.; of strychnine sulphate gr. 1/120. Multiply each dose by 30:

Reduced iron ..... gr.ii. $\times$ 30 = gr.60
Aloes ..... gr.½ $\times$ 30 = gr.15
Strychnine ..... gr.$\frac{1}{120}$ $\times$ 30 = gr.¼

The Latin of aloes socotrine is *aloe,* genitive *aloe-s,* of aloes; *socotrina,* genitive *socotrin-æ,* of socotrine.

The Latin of strychnine sulphate is *strychnina,* genitive *strychnin-æ,* of strychnine; *sulphas,* genitive *sulphat-is,* of sulphate.

The Latin of reduced iron is *ferrum,* genitive *ferr-i,* of iron: *reductum,* genitive *reduct-i,* of reduced. Hence:

℞
Ferri reducti ..... 3 i.
Aloës socotrinæ ..... gr.xv
Strychninæ sulphatis ..... gr.¼
Misce et divide in pilulas ..... xxx.
(Abbreviated) M. et div. in pil. xxx.
Signa. Give one pill three times daily.

JOHN SMITH.

The Latin names of the drugs being put in the genitive, and the signs and numbers for the proper quantities and amounts added, we come to the Latin directions to the pharmacist. (Misce) mix (et) and (divide) divide (in pilulas, accusative plural) in pills xxx. This is a regulation phrase and can be employed whenever we write a prescription for pills, so that it should be memorized. It can be abbreviated correctly as follows:

M. et div. in pil. xxx.

Instead of writing the prescription as just described, we can calculate the dose needed of each ingredient in the pill, and then write a prescription for one pill and direct the pharmacist to make 30 pills like it.

℞

Ferri reducti .....gr.ii.
Aloës socotrinæ .....gr.ss.
Strychninæ sulphatis .....gr.$\frac{1}{120}$
Misce et fiat pilula 1; dispense pilulas tales numero xxx.
(Abbreviated) M. et f. pil. 1. Dispense pil. tales No. xxx.
Signa or S. (as before.)

Translated: (Misce) mix (et) and (fiat) let there be made (pilula) pill 1; (dispense) dispense (pilulas) pills, (tales) such, (numero) in number, xxx. Abbreviated as above, (Signa) S.= Label.

The same prescription may be written in the metric system: Gr. 1=.06 gm. Fractions of a grain are converted into grams, therefore, by dividing .06 by the denominator of the fraction and multiplying the result by the numerator. The dose of aloes (gr. ½) is transformed into grams, then, as follows:

2).06(.03 × 1 = .03
06
——
00

Gr. 1/120 is converted into grams thus:

120).0600(.0005 × 1 = .0005 gm.
600

Solids in Gm. Liquids in Cc.

℞

Ferri reducti	12
Aloës socotrinæ	03
Strychninæ sulphatis	0005

M. et f. pil. 1; dispense pil. tales No. xxx.
Sig. (as before).

This prescription may be abbreviated in this manner:

Ferri reducti	12
Aloës soc	03
Strych. sulph.	0005

M., etc.

Prescriptions for balls are calculated and written in every respect like those for pills. We may write the above prescription in another form, in case we prescribe a pill or ball mass to be made, or an official mass to be divided into pills. Suppose we write a prescription for a physic mass, suitable for horses. We conclude to write for a quantity of the mass sufficient to make eight balls. Each ball contains a single dose of aloes and sufficient excipient to make the mass of the proper consistency. The dose of aloes is one ounce, and we know by experience that it will take an equal amount of molasses and one drachm of powdered ginger to make a proper ball mass. Multiplying each of the ingredients, then, by 8, we find we need 8 ounces each of aloes and molasses, and 1 ounce of pulverized ginger, to make a mass which shall be divided into 8 balls.

The Latin names and genitives of socotrine aloes we have already described. Molasses is *syrupus fuscus* in Latin, or brown syrup. *Syrupus,* genitive *syrup-i,* of syrup. *Fuscus,* genitive *fusc-i,* of brown. The Latin for powdered ginger is *pulvis,* powder, genitive *pulver-is,* of powder. *Zingiber,* ginger, genitive *zingiber-is,* of ginger.

We will proceed to write the prescription thus:

℞
Aloës socotrinæ
Syrupi fusci .....āā ℥ viii.
Pulveris zingiberis .....℥ i.
Misce et fiat massa, in bolos viii., dividenda.
(Abbreviated) M. et f. mass., in bolos viii., dividend.
Sig. Give one ball at once.

JOHN SMITH

The Latin directions to the pharmacist are translated: (Misce) mix (et) and (fiat) let there be made (massa) a mass (in bolos, accusative pl.), in balls viii. (dividenda) to be divided.

This is also a stock phrase and should be memorized as applying to pills or balls made from a mass.

The prescription is abbreviated:

℞
Aloës soc.
Syr. fusci .....āā ℥ viii.
Pulv. zingiber .....℥ i.
M. et f. mass., in bolos viii., dividend. (as above)
Or: Misce et divide in bolos viii.
(Abbrev.) M. et div. in bolos viii.

Translated: Mix and divide into balls 8.

Or: M. et fac bolos viii. (abbrev.) M. et f. bolos viii.

Translated: Mix and make balls 8.

Mixtures are compounds in which fluids are mixed or solids dissolved or held in suspension by a suitable vehicle. We must first decide upon the number of doses which we wish to prescribe, and then the quantity of the mixture to be given at each dose.

Suppose we wish to give sweet spirit of nitre and quinine to a horse. We propose to give the mixture three times daily for several days. The dose of the nitrous ether will be an ounce; the quinine will be dissolved in it. Bottles are in use containing 12 to 16 ounces, or 1 pint. We will decide upon the pint bottle. This, then, will hold 16 ounces, or 16 doses of sweet spirit of nitre. In each dose of the nitre we want dissolved gr. 20 of quinine sulphate. $16 \times$ gr. 20 = gr. 320 = ʒ v. ℈ i. Now, 5 drachms of quinine sulphate will not dissolve in 16 ounces of sweet spirit of nitre, so that we will add enough diluted sulphuric acid to dissolve the quinine. We do not know how much sulphuric acid will be required, so we write after acid sulphuric, Q. S., for quantum sufficiat, *i.e.*, as much as suffices (to dissolve, understood).

Again, we do not know exactly how much bulk* the quinine will take up when dissolved in the nitre; nor what amount of acid will be required. Yet, on the other hand, we want to fill our bottle. To get over these difficulties we will write after sweet spirit of nitre *ad*, underlined (to); in other words, we order the druggist to take of sweet spirit of nitre enough to (make, understood) a pint.

The Latin for quinine is *quinina*, genitive *quinin-æ*, of quinine. The Latin for sulphate is *sulphas*, genitive *sulphat-is* of sulphate The Latin for spirit of nitrous ether is *spiritus*, genitive *spiritus*, of spirit; *nitrosus*, genitive *nitros-i*, of nitrous; *æther*, genitive *æther-is*, of ether. The Latin for sulphuric acid diluted is *acidum*, genitive *acid-i*, of acid; *sulphuricus*, genitive *sulphuric-i*, of sulphuric; *dilutus*, genitive *dilut-i* of diluted.

We may now write our prescription as follows:

℞

Quininæ sulphatis .....ʒ v. ℈ i.
Acidi sulphurici diluti.....Q. S.
Spiritus ætheris nitrosi ad.....Oi.

Misce.

(Furnish ʒ i. bottle for measure).

Signa. Small bottleful three times daily in half a pint of water.

JOHN SMITH.

* The increase in volume of the drench through the addition of this amount of quinine would be negligible, but in cases where large quantities of solids are dissolved in liquids the increase in volume is marked.

Abbreviated:

℞

Quin. sulph.....3 v. ℈i.
Acid. sulphurici dil.....Q. S.
Spts. æther. nitrosi ad.....Oi.

M.
S. (as above).

We will write a prescription for a mixture containing 12 doses of chloral and potassium bromide for a dog. The quantity of the mixture given to each dose will be a teaspoonful. Now, there are six teaspoonfuls in one ounce. We will order a 2-ounce bottle, which will, therefore, hold 12 doses of a teaspoonful each. The dose of chloral is gr.v 5×12=gr.60, or 3 i. The dose of potassium bromide is gr.x. 10×12=gr.120, or 3 ii. Then we will order enough water to fill the bottle. The Latin for chloral is *chloral,* genitive *chloral-is,* of chloral; Latin for potassium bromide is *potassium,* genitive *potassi-i,* of potassium; *bromidum,* genitive *bromid-i,* of bromide; Latin for water is *aqua,* genitive *aqu-æ,* of water.

℞

Chloralis .....3 i.
Potassii bromidi .....3 ii.
Aquæ ad .....℥ ii.

M.
Signa. Teas. in 1 tablespoonful of water every 3 hours.

JOHN SMITH.

A drench is a mixture which is given the horse in one dose. We will write a prescription for a horse, containing ether, chloroform and laudanum, to be administered as a drench. The Latin for ether is *æther,* genitive *æther-is,* of ether; dose, ℥ i. The Latin for chloroform is *chloroformum,* genitive *chloroform-i,* of chloroform; dose, 3 ii. The Latin for laudanum is *tinctura opii; tinctura,* genitive *tinctur-æ,* of tincture; *opium,* genitive *opi-i,* of opium; dose, ℥ ii. The prescription reads:

℞

Ætheris .....℥ i.
Chloroformi .....3 ii.
Tincturæ opii.....℥ ii.
Misce et fiat haustus.

Translated: (Misce) mix, (et) and (fiat) let there be made (haustus) a drench.

(Abbreviated) M. et f. haust.
Sig. Give at once in one dose in pint of water.

JOHN SMITH.

In writing a prescription for powders, we may either write for one powder and direct the druggist to dispense several more like it, or write for the whole amount of the ingredients and order them divided into the required number of doses or papers. In the first case we will write for a powder containing one dose of each of the drugs.

For example, we write a prescription for calomel and santonin, with sugar of milk as an excipient, since the dose of the drug is inconveniently small. This powder is suitable for a medium-sized dog.

The Latin for calomel, or the lower chloride of mercury, is *hydrargyrum,* genitive *hydrargyr-i,* of mercury; *chloridum,* genitive *chlorid-i,* of chloride; *mite,* genitive *mit-is,* of lower; dose, gr.ii. The Latin for santonin is *santoninum,* genitive *santonin-i,* of santonin; dose, gr.i. The Latin for sugar of milk is *saccharum,* genitive *sacchar-i,* of sugar; *lac,* genitive *lac-tis,* of milk; amount gr.x. The prescription will read:

℞

Hydrargyri chloridi mitis.....gr. ii.
Santonini .....gr. ii.
Sacchari lactis.....gr. x.
Misce et fiat pulvis 1; dispense pulveres tales vi.

Translated: Mix, and let there be made powder 1; dispense powders such vi.

(Abbreviated) M. et f. pulv. 1; dispense pulv. tales vi.
Sig. One powder every half hour until 4 doses are given.

JOHN SMITH.

In the second case, if we write a prescription for six powders, we multiply the dose of the ingredients in each powder by 6, and then order the prescription to be dispensed in six papers.

℞

Hydrarg. chlorid. mitis.....gr.xii.
Santonin .....gr.vi.
Sacch. lactis.....3 i.
Misce et divide in chartulas numero.....vi.

Translated: Mix and divide into papers in number vi.

Sig. (as before).

To write the above in the metric system. The dose of calomel is gr.ii.=.12 gm. .12×6=.72, or gr.xii. The dose of santonin is gr.i.=.06 gm. .06×6=.36 gm., or gr.vi. The amount of sugar of milk used as an excipient in each powder is gr.x. .06×10 =.6 gm., the amount prescribed in each powder. The amount necessary for six powders is 6×6=3.6 gm., approximately 4 gm.

℞

	Solids in Gm.	Liquids in Cc.
Hydrarg. chlorid. mitis		72
Santonin		36
Sach. lactis	4	

M. et div. ch't. in No. vi

Sig. (as before).

We will write a prescription for a horse, in the form of a powder, containing dried iron sulphate, nux vomica and sodium bicarbonate. The Latin for iron sulphate (dried) is *ferrum,* genitive *ferr-i,* of iron; *sulphas,* genitive *sulphat-is,* of sulphate; *exsiccatus,* genitive *exsiccat-i,* of dried; dose, ʒ i. The Latin for nux vomica is *nux,* genitive *nuc-is,* of nut; *vomica,* genitive *vomic-æ,* of vomica; dose, ʒ i. The Latin of sodium bicarbonate is *sodium,* genitive *sodi-i,* of sodium; *bicarbonas,* genitive *bicarbonat-is,* of bicarbonate. We will order a sufficient quantity of the ingredients to make thirty powders. The dose of iron and nux vomica is ʒ i.×30=℥ iii., ʒ vi. The dose of sodium bicarbonate is ʒ ii.×30=℥ vii.ss.

℞

Ferri sulphatis exsiccati
Pulveris nucis vomicæ.....āā ℥ iii., ʒ vi
Sodii bicarbonatis.....℥vii.ss.
Misce et divide in chartulas xxx.

Translated: Mix and divide into papers xxx.

(Abbreviated) M. et div. in chart. xxx.

Sig. Give one powder three times daily on the food.

JOHN SMITH.

In order to avoid the expense of having powders divided into papers, we may frequently direct one dose to be weighed by the druggist, and a measure to be furnished holding the quantity.

℞

Ferri sulph. exsicc.
Pulv. nucis vom.....āā ʒ iii., ʒ vi.
Sod. bicarb.....ʒ vii. ss.
Misce et fiat pulvis.

Translated: Mix and let there be made a powder.
(Abbreviated) M. et f. pulv. (Furnish measure holding ʒ ss.)
Sig. Give measureful on food three times daily.

JOHN SMITH.

To transform this prescription into terms of the metric system: ʒ i.=Gm.30.; ʒ i.=Gm. 4. Hence ʒ iii., ʒ vi=Gm.114; ʒ vii.ss.=Gm.225.

℞

Solids in Gm. Liquids in Cc.

Ferri sulph. exsicc.
Pulv. nucis vom.....āā 114 |
Sodii bicarb.....225 |
M. et f. pulv., etc.
S. (as before).

Electuaries are not suitable preparations in which to prescribe powerful drugs, as we cannot secure any degree of accuracy in the dosage. This happens because we do not usually know the exact amount of excipient which will be required to make the paste of the proper consistency. We will write for an electuary containing potassium chlorate, licorice and molasses. The Latin for potassium chlorate is *potassium,* genitive *potassi-i,* of potassium; *chloras,* genitive *chlorat-is,* of chlorate; dose, ʒ ii. The Latin for powder of licorice root is (powder has been given before) *glycyrrhiza,* genitive *glycyrrhiz-æ,* of licorice; *radix,* genitive *radic-is,* of root. The Latin for molasses is *syrupus,* genitive *syrup-i,* of syrup; *fuscus,* genitive *fusc-i,* of brown; dose of licorice root and molasses immaterial. They are used as excipients.

℞

Potassii chloratis
Pulveris glycyrrhizæ radicis..āā..ʒ vi.
Syrupi fusci.....Q.S.
Misce et fiat electuarium.

Translated: Mix and let there be made an electuary.
(Abbreviated) M. et f. electuarium.
(Weigh 3 vi. as sample).
S. Give amount equal to sample every 2 hours smeared on teeth.

JOHN SMITH.

We cannot tell precisely what quantity of potassium chlorate will be administered in the ʒvi. ordered in this prescription, but we can be assured that it will not be larger than 3 drachms, which is a small dose for the horse.

Suppositories are occasionally prescribed to dogs. The excipient is cacao butter, of which about 15 grains is required. We will write a prescription containing iodoform and extract of Belladonna root, to be dispensed in suppositories for a medium-sized dog. The Latin for iodoform is *iodoformum,* genitive *iodoform-i,* of iodoform; dose, gr.½. The Latin for extract of belladonna root is *belladonna,* genitive *belladonn-æ,* of belladonna; *extractum,* genitive *extract-i,* of extract; *radix,* genitive *radic-is,* of root; dose, gr.¼. The Latin for cacao butter is *oleum theobroma; oleum,* genitive *ole-i,* of oil; *theobroma,* genitive *theobromatis,* of theobroma. The quantity of cacao butter may be safely left to the discretion of the pharmacist. We will multiply the dose by ten, to make ten suppositories.

℞

Iodoformi .....gr.v.
Extracti belladonnæ radicis.....gr.ii.ss.
Olei theobromatis.....q.s.
Misce et fiant suppositoria x.

Translated: Mix and let there be made suppositories x.
(Abbreviated) M. et f. suppos. x.
Sig. Introduce one into the bowel every 4 hours.

JOHN SMITH.

In writing prescriptions for ointments the degree of dilution of the medicinal substance, or substances, must be determined. In case the dilution is done in percentage, the metric system is particularly useful. A five-per-cent. ointment of the yellow oxide of mercury is of value in some cases of conjunctivitis. We will write for 5 gm.

The Latin for yellow oxide of mercury is *hydrargyrum oxidum flavum; hydrargyrum,* genitive *hydrargyr-i,* of mercury; *oxidum,* genitive *oxid-i,* of oxide; *flavum,* genitive *flavi,* of yellow.

The excipient will be simple ointment. Latin for simple ointment is *unguentum,* genitive *unguent-i,* of ointment. If we order 5 gm. of simple ointment we can determine the amount of mercury necessary to form a 5-per-cent. preparation with it by simply moving the decimal line forward two places, .05, which will give a 1-per-cent. ointment of mercury; and then, by multiplying by 5, $.05 \times 5 = .25$, we secure a 5-per-cent. ointment.

℞

	Solids in Gm.	Liquids in Cc.
Hydrargyri oxidi flavi.....		25
Unguenti	5	
Misce et fiat unguentum.		

Translated; Mix and let there be made an ointment.
(Abbreviated) M. et f. ung.
Sig. Use externally.

JOHN SMITH.

There is nothing of special note to consider in regard to writing prescriptions for liniments. We will write a prescription for Carron oil as an example.

Carron oil is composed of equal volumes of solution of lime and cottonseed oil. The Latin for oil of cottonseed is *oleum gossipii seminis, oleum,* genitive *ole-i,* of oil; *gossypium,* genitive *gossypi-i,* of cotton; *semen,* genitive *semin-is,* of seed. The Latin for solution of lime is *liquor calcis; liquor,* genitive *liquor-is,* of liquor; *calx,* genitive *calc-is,* of lime.

℞

Liquoris calcis.
Olei gossypii seminis.....āā ʒ iii.
Misce et fiat linimentum.

Translated: Mix and let there be made a liniment.
(Abbreviated) M. et f. liniment.
Sig. Apply externally.

JOHN SMITH.

CLASSIFICATION.

PART I.

Inorganic Agents.

Section I.—Water, and Solution of Hydrogen Dioxide.
Section II.—Alkaline Metals; Potassium, Sodium, Ammonium and Lithium.
Section III.—Alkaline Earth Metals; Calcium, Barium, Magnesium, Heavy Metals; including Sections IV–VI.
Section IV.—Aluminum, Cerium, Plumbum, Argentum, Zincum, Cuprum and Bismuthum.
Section V.—Ferrum, Manganum.
Section VI.—Hydrargyrum.
Section VII.—Arsenic, Atoxyl, Sodium Cocodylate, Antimony.
Section VIII.—Phosphorus.
Section IX.—Chlorine, Iodine, Bromine, Orthoform.
Section X.—Sulphur.
Section XI.—Acids.
Section XII.—Carbon Compounds.
- Class 1. Carbon.
- Class 2. Alcohol, Ether, Chloroform.
- Class 3. Nitrites.
- Class 4. Chloral, Chloretone.
- Class 5. Antipyretics, Analgesics.
- Class 6. Antiseptics.
- Class 7. Miscellaneous Carbon Compounds.

PART II.

Vegetable Drugs.

Section I.—Drugs acting on the brain.
- Class 1. Depressing the brain; Opium.
- Class 2. Stimulating the brain; Belladonna.

Section II.—Drugs acting on the spinal cord.
- Class 1. Stimulating the inferior cornua; Nux Vomica, Strychnine.
- Class 2. Depressing the inferior cornua; Physostigma, Gelsemium.

Section III.—Drugs acting chiefly on the motor nerves.

Class 1. Depressing the motor nerves; Tobacco and Conium.

Section IV.—Drugs acting on the sensory nerves.

Class 1. Depressing the sensory nerves; Cocaine, Eucain, Stovaine, Holocain, Yohimbine, Novocaine.

Section V.—Drugs acting on the secretory nerves.

Class 1. Stimulating the secretory nerves; Pilocarpus.

Section VI.—Drugs acting on the heart.

Class 1. Increasing the force and decreasing the frequency of the heart; Digitalis, Strophanthus, Convallaria and Squill.

Class 2. Decreasing the force and frequency of the heart; Aconite, Veratrum Viride and Album, Veratrine.

Section VII.—Drugs acting on the respiration; Ipecac.

Section VIII.—Vegetable Antipyretics and Antiseptics.

Class 1. Cinchona and its Alkaloids.

Class 2. Salicylic Acid, Salicin, Salol, Oil of Gaultheria and Methyl Salicylate, Aspirin.

Section IX.—Volatile Oils or Drugs containing them.

Class 1. Used mainly for their action on the skin: Turpentine, Oil of Turpentine, Terebene, Terpin Hydrate, Burgundy Pitch, Canada Turpentine, Resin, Tar, Pitch, Oil of Cade, Balsam of Peru, Balsam of Tolu, Benzoin, Benzoic Acid, Black and White Mustard, Fibrolysin, Thiosinamine, Eucalyptus, Arnica, Myrrh.

Class 2. Used mainly for their stomachic and carminative action upon the digestive tract: Capsicum, Ginger, Peppermint, Menthol, Spearmint, Anise, Cardamon, Coriander, Fennel, Fenugreek.

Class 3. Used mainly for their antispasmodic action in stimulating the nervous system: Valerian, Ammonium, Ferric and Zinc Valerianates, Asafœtida and Ammoniacum.

Class 4. Used mainly for their stimulant and diuretic action on the genito-urinary tract: Buchu and Oil of Juniper.

Class 5. Used mainly for its emmenagogue action on the female generative organs; Savin.

Section X.—Vegetable Bitters.—Gentian, Quassia, Cascarilla, Calumba, Taraxacum, Hydrastis, Calamus.

Section XI.—Vegetable Cathartics.

Class 1. Simple Purgatives.—Aloes, Linseed Oil, Castor Oil, Rhamnus Purshiana, Phenolphthalein, Frangula, Rhamnus Catharticus, Rhubarb (Chrysarobin), Senna.

Class 2. Drastic Purgatives.—Croton Oil, Scammony, Jalap, Gamboge, Elaterin, Colocynth, Podophyllum, Podophylin.

Section XII.—Tannic Acid and Drugs containing it.

Nutgall, Tannic Acid, Gallic Acid, Pyrogallol, White Oak, Catechu, Kino, Krameria, Hematoxylon, Hamamelis.

Section XIII.—Vegetable Demulcents.

Olive Oil, Cottonseed Oil, Soap, Soft Soap, Glycerin, Linseed, Acacia, Tragacanth, Althæa, Sugar.

Section XIV.—Vegetable Drugs killing Parasites.

Class 1. Used to destroy tape worms: Aspidium, Areca Nut, Kamala, Kouso, Granatum.

Class 2. Used to destroy round worms: Santonica.

Class 3. Used to destroy oxyurides: Quassia.

Class 4. Used to destroy lice: Stavesacre.

Class 5. Used to destroy fleas: Pyrethrum.

Section XV.—Vegetable Drugs stimulating unstriated muscle, particularly of the uterus.

Ergot, Cotton Root Bark.

Section XVI.—Colchicum.

Section XVII.—Vegetable Drugs acting mechanically.

Starch, Oil of Theobroma, Purified Cotton, Pyroxylin, Collodion, Euphorbium.

Section XVIII.—Medicinal Agents of Animal Origin.

Adrenalin, Cantharides, Lard, Suet, Hydrous Wool Fat, Yellow and White Wax, Spermaceti, Honey, Milk, Sugar, Pepsin, Pancreatin, Ox Gall, Papain, Cod Liver Oil, Ichthyol, Thiol.

NOTE.

ABBREVIATIONS USED IN REFERENCE TO THE SYNONYMS IN THE DESCRIPTIONS OF DRUGS.

B. P. ..... British Pharmacopœia.
E. ..... English.
P. G. ..... German Pharmacopœia.
Fr. ..... French.
G. ..... German.

Three doses of each medicine are usually given; one for horses and cattle; one for sheep and swine, and one for cats and dogs, unless otherwise specified. The quantities are expressed in units of the Apothecaries' Weight or Wine Measure and also in the metric system. The solids in the latter to be dispensed in grams, the liquids in cubic centimeters. Only those official drugs and preparations of the United States and British Pharmacopœia's will be mentioned, which are considered to be of value to practitioners of Veterinary Medicine. In connection with doses the following abbreviations are used:

H. ..... Horse.
C. ..... Cattle.
Sh. & Sw. ..... Sheep and Swine.
D. ..... Dogs.

The same dose may be given to either dogs or cats of equal weight.

PART I.

INORGANIC AGENTS.

SECTION I.

Water.

AQUA, Water. AQUA DESTILLATA, Distilled Water. H_2O. (The latter used in filling many prescriptions.)

Action external.—The reader is referred to special articles on "Cold and Heat" (p. 632), "Food and Feeding" (p. 612), and "Counter Irritants" (p. 626), for details concerning the action and uses of water, respectively, as a medium of heat and cold, as an article of diet in health and disease, and as a counter irritant. Cold water, externally, at first stimulates reflexly heat production, with slight rise of temperature, increased carbonic acid elimination and contraction of the vessels and muscles of the skin. If the cold water application is continued, the bodily heat falls, owing to physical abstraction of heat. "Reaction" follows the removal of cold, if properly applied, with dilatation of the superficial vessels (and sensation of warmth and exhilaration in man). Moderate warm water (105° F.) applications stimulate cutaneous vascularity, favor diaphoresis, and diminish urinary secretion. Hot water (110°–120° F.) applications act as counter irritants in dilating the peripheral vessels, contracting those in more remote parts, and relieving pain, spasm, congestion and inflammation.

Action internal.—Water is quickly absorbed and thus swells the secretion of urine, and, to a less extent, that of bile, saliva and pancreatic juice. Intestinal peristalsis is facilitated by a considerable amount of water. Water also increases tissue change, and elimination of carbonic dioxide and urea; promotes the appetite and washes out the tissues and urinary tract, thus removing waste matters from the body. The elimination of uric acid is lessened by water. Large quantities of water, *if* not taken at meal time—when

they dilute the digestive juices and disorder digestion—favor the formation of fat.

Uses external.—See "Heat and Cold," p. 632.

Uses Internal.—Healthy animals may be given as much water as they desire, with certain restrictions in relation to work and feeding. It is unwise to allow horses much water, either immediately before or after severe work, or after feeding. If water is given before severe work it increases the bulk of intestinal contents, is apt to cause digestive disturbance, and interferes with the movements of the diaphragm. For these same reasons water should only be permitted in small amount (at a time) in "heaves" of horses.

If a quantity of cold water is allowed horses after hard work, colic is very likely to occur. Working horses should, therefore, be watered, in reasonable amount, while at work; and, if this is impracticable, may be allowed but a few mouthfuls of water, or a gallon of oatmeal gruel after severe work, with whole hay but no grain until after an hour's rest. When horses at rest drink much water after eating, the contents of the stomach (which is unusually small in this animal) are washed into the intestines and are not so thoroughly digested. This accomplishes two bad results: it deprives the animal of some nourishment and engenders digestive trouble and diarrhea.

The best plan is to give resting horses water before eating, or to keep it at their command at all times. Cold water is desirable, frequently and in unlimited quantities, in fever, although there is a popular fear of it. Water is more valuable than any other known agent in fever to eliminate toxins. Drinking should be encouraged by putting salt on the food and by keeping water always at the animal's disposal. Also by giving large enemata of normal salt solution (p. 657). Hot water assists the action of diaphoretics; cold water that of diuretics. Lukewarm water is an emetic, but hot water, in small and repeated doses, allays nausea and vomiting. Water is restricted in ordinary diarrheas, obesity, and to assist the absorption of exudations. The drinking of water should be encouraged by a liberal allowance of salt (which in itself aids digestion), in animals in a poor condition, to increase their appetite and flesh. Water is valuable in diluting a concentrated urine from which calculi are liable to be deposited. High rectal injections of water are absorbed, and consequently flush out the kidneys.

Solution of Hydrogen Dioxide.

Aqua Hydrogenii Dioxidi. Solution of Hydrogen Dioxide. (U. S. P.)

Synonym.—Liquor Hydrogenii Peroxidi, Hydrogen Peroxide. A slightly acid aqueous solution of hydrogen dioxide (H_2O_2) containing, when freshly prepared, about 3 per cent., by weight, of the pure dioxide, corresponding to about 10 volumes of available oxygen.

Derivation.—Add barium dioxide, 300, to cold, distilled water, 500; agitate and keep at a temperature of 100° C. (50° F.). To this mixture (of barium hydrate) add a solution of phosphoric acid, 96, in cold distilled water, 320, and shake them together thoroughly. Filter, and wash the precipitate (barium phosphate) with distilled water until the filtrate measures 1000. Add diluted sulphuric acid to the filtrate (until cloudiness disappears in a small filtered portion of it; absence of barium), and starch 10. Agitate frequently. Filter and refilter till the solution becomes clear.

Properties.—A colorless liquid, without odor, acidulous to the taste and producing a peculiar sensation and soapy froth in the mouth; liable to deteriorate by age, exposure to heat, or protracted agitation. Spec. gr. 1,006 to 1,012.

Reaction slightly acid. When exposed to the air at the ordinary temperature, or when heated in a water bath at a temperature not exceeding 60° C. (140° F.) the solution loses chiefly water. When rapidly heated it is liable to decompose suddenly. (The value of a given sample of hydrogen dioxide may be roughly ascertained by adding a few drachms to a few crystals of potassium permanganate in a test tube. The greater the amount of effervescence the better the hydrogen dioxide.—Wallian.)

Dose.—H. & C., ʒ i-ii. (30.-60.); D., ʒ i.-ii. (4.-8.)

Action and Uses.—Hydrogen dioxide is probably the most powerful, non-toxic, surgical antiseptic and disinfectant. It is not poisonous to higher animals, and liberates oxygen immediately in the presence of all forms of living matter, excised organs, and drawn blood, thus destroying all bacteria and organized ferments. It is, moreover, a most efficient cleansing agent in wounds, the gaseous froth mechanically removing detritus better than irrigation. It thus acts like soap-suds in ordinary washing processes. Injected

intravenously hydrogen dioxide causes death through the formation of gas (oxygen) emboli—in its catalysis in the blood—by plugging the heart and blood-vessels of the brain and lungs.

The microbicidal action is transient and not persistent; only water remains. Therefore hydrogen dioxide is useless for the production of continuous antiseptic action. The drug is an antiseptic in the digestive tract, and some oxygen may be absorbed by the blood, but this is extremely doubtful. The official solution contains 10 volumes of oxygen; that is, it yields up 10 times its bulk of oxygen gas. Most proprietary preparations are stronger, and contain 12 volumes of oxygen, and are more powerfully disinfectant.

Hydrogen peroxide is particularly valuable as an antiseptic on suppurating and septic wounds, necrosed tissue, abscess cavities, sinus', ulcers, morbid growths and suppurating mucous membranes. In fistulæ of the withers and poll, hydrogen dioxide acts as an efficient cleansing and antiseptic agent, and it should be injected prior to the use of other antiseptics, stimulants and caustics, as carbolic acid in glycerin (see p. 301). Hydrogen dioxide is probably the best remedy we possess in the treatment of acute catarrh of the pharynx and tonsils in dogs and cats when applied directly to the throat, diluted with two parts of lime water, with an atomizer or brush, or on absorbent cotton on an applicator. It is commonly employed in full strength and only in glass, porcelain, or hard rubber vessels or instruments. The drug should not be used in cavities where an outlet for the free escape of gas is wanting. Peroxide of hydrogen decomposes pus with effervescence, and thus is a guide to its presence or absence; it also destroys the pus cocci.

Hydrogen dioxide is a safe and efficient agent in disinfecting drinking water, and is of some value in gastric fermentative indigestion of dogs where the vomitus and feces show evidence of gas formation or frothiness, and is absolutely safe. Recently good results have been reported from the use of hydrogen dioxide, diluted with three parts of lime water, in dysentery when given as high enemata twice daily.

SECTION II.

ALKALINE METALS—POTASSIUM, SODIUM, AMMONIUM, LITHIUM.

Potassium.

Potassium is not used in medicine in the metallic state. Its compounds may be considered in three groups; 1, Potassa; 2, the Carbonates (acetate and citrate); 3, the Mineral Salts.

Potassium compounds were formerly obtained from wood ashes by lixiviation; from sea water by evaporation, and from argol, a substance deposited in wine casks. Now they are obtained from potassium muriate, mined in Stassfurt, Saxony, which is thought to result from the boiling away of sea water in past ages.

GENERAL ACTION OF POTASSIUM SALTS.*

In lethal doses the action of all the potassium compounds is very similar.

Stomach and Intestines.—The potassium salts, with the exception of the vegetable compounds, are irritants to the gastro-intestinal tract, if ingested in concentrated form.

Heart.—When injected into a vein, potassium has a direct, paralyzing action on the heart muscle, and in lethal doses there is cardiac arrest in diastole. Much the same action is, moreover, observed on all higher forms of tissue. The functional activity of the nerves and muscles is depressed and abolished, more especially that of the brain and cord, so that paralysis of central origin occurs.

Potassium has, however, no depressing influence upon the heart when given by the mouth, as enormously greater amounts than are ever given medicinally are daily consumed in the food. Bunge estimates from 50 to 100 gms. may be thus daily ingested in food by man. This fact explodes the fallacy that sodium salts are less depressant to the heart than the corresponding salts of potassium and are preferable as medicinal agents to the latter.

Blood.—When given for any considerable period, the potassium, like the sodium salts, impoverish the system and produce a more

* The action of salts on the body is determined not by the action of the chemical compound or its molecule but by the action of the ions which are dissociated when the salt goes into solution. Thus the action of Potassium on the body may be studied by observing the action of KCl since the influence of the Cl ion (anion) may be ignored as it induces no physiological effect upon the organism.

fluid state of the blood. Large doses of the potassium salts are likely to occasion purging, while small doses are apt to cause diuresis. The carbonates and vegetable salts resemble each other in action, but that of the mineral salts is peculiar to the individual compound.

Potassii Hydroxidum. Potassium Hydroxide. KOH. (U. S. P.)

Synonyms.—Potassa caustica, B. P.; potash, potassium hydrate. caustic potash, lapis causicus chirurgorum, E.; potasse caustique, Fr.; aetz kali, G; kali causticum fusum, P.G.

Derivation.—A solution of potassium hydrate is evaporated; the residue is fused and run into moulds.

Properties.—Dry, white, translucent pencils or fused masses, hard and brittle, showing a crystalline fracture; odorless, or having a faint odor of lye, and of a very acid and caustic taste. Exposed to the air, it very rapidly absorbs carbon dioxide and moisture, and deliquesces. Soluble at 25° C. (77° F.)* in about 0.4 part of water, and in 2 parts of alcohol; very soluble in boiling water and in boiling alcohol; slightly soluble in ether.

Liquor Potassii Hydroxidi. Solution of Potassium Hydroxide. (U. S. P.)

An aqueous solution of potassium hydroxide (KOH), containing about 5 per cent. of the hydroxide.

Synonym.—Liquor potassae, B. P.; solution of potassium hydrate, kali hydricum solution, lixivium causticum, solution of potash, E.; potasse caustique liquide, lessive caustique, Fr.; aetz-kalilauge, G.; liquor kali caustici, P. G.

Derivation.—Boiling a solution of potassium carbonate with calcium hydrate leaves potassium hydrate in solution, while calcium carbonate is precipitated.

$$K_2CO_3 + Ca(OH)_2 = 2\ KOH + Ca\ CO_3.$$

Properties.—A clear, colorless liquid, odorless, having a very acrid and caustic taste and a strongly alkaline reaction. It has a soapy feel and taste.

Dose.—H. & C., ʒ ss.-i. (15.-30.); Sh. & Sw., 3 ss.-i (2.-4.); D., ♏ v.-xx. (.3-1.3).

* When solubility is mentioned hereafter, reference will be had to solubility at the above temperature.

Potassa Cum Calce. Potassa with Lime. (Non-official.)

(Equal parts of potassa and lime.)

Synonym.—Vienna paste.

Properties.—A grayish-white powder, deliquescent, having a strongly alkaline reaction; should be soluble in diluted hydrochloric acid without leaving more than a small residue.

Action and Uses.—Potassium hydroxide, its solution, and potassa cum calce are mainly of value as escharotics. Liquor potassæ is unfit for internal use unless greatly diluted with water. It resembles potassium carbonate in its effects. Caustic potash is very destructive of tissue by dissolving proteids and forming alkali-proteids. It is most diffusible and, therefore, difficult to limit its action. This we may do, however, by applying a plaster to a part, with a hole in it, through which the caustic stick is applied. Before using the caustic, the outside of the plaster should be covered with oil or grease, but not the part under the aperture in it. After removing the plaster the operation of the caustic may be arrested by vinegar. Cauterization by this means is very painful under ordinary circumstances, but may be made comparatively painless by incorporating one part of morphine muriate with three parts of potassa cum calce, and adding enough chloroform to make a paste.

Caustic potash is indicated where extensive destruction of tissue is desirable, as in the treatment of the bites of rabid dogs and of snakes. It is less commonly used for the removal of warts, and small growths, and as a caustic on indolent or exuberant granulations.

Potash has been employed to form an issue, or artificial ulcer for the production of counter irritation. Potash may be prescribed in bronchitis, for its action, common to the alkalies, in thinning and increasing the bronchial secretions. An excellent mild stimulating liniment consists of:

℞

Ol. terebinthinæ	50.00
Ol. succini	20.00
Saponis pulv	10.00
Potassæ	2.00
Aquæ ad	1,000.00

M. et fiat linimentum.

The potash saponifies the oils and exerts a stimulating action on the skin. Potassium bicarbonate is less irritating and more suitable for the latter indication. Potash is sometimes recommended

as an antacid and sedative in gastric disorders, but is inferior to sodium bicarbonate for this purpose.

Potassii Carbonas. Potassium Carbonate. K_2CO_3. (U. S. & B. P.)

Synonym.—Salts of tartar.

Derivation.—The solution resulting from the lixiviation of wood ashes is boiled to dryness, and the resultant mass is the "potash" of commerce. This is purified to some extent by burning in ovens, forming "pearlash," a mixture of the hydrate and carbonate. Water dissolves mainly the carbonate which is obtained by evaporation of the aqueous solution.

Properties.—A white, granular powder, odorless, and having a strongly alkaline taste; very deliquescent. Soluble in 0.9 part of water; insoluble in alcohol.

Dose.—H. & C., ℥ ss.-i. (15.-30.); Sh. & Sw., ʒ ss.-i. (2.-4.); D., gr.v-xx (.3-1.3).

Potassii Bicarbonas. Potassium Bicarbonate. $KHCO_3$. (U. S. & B. P.)

Synonym.—Doppelkohlensaures kali, G.

Derivation.—Obtained by passing a stream of CO_2 through a solution of the carbonate.

$$K_2CO_3 + CO_2 + H_2O = 2\ KHCO_3.$$

Properties.—Colorless, transparent, monoclinic prisms, odorless and having a saline and slightly alkaline taste. Permanent in the air. Soluble in 3 parts of water. Almost insoluble in alcohol. Becomes converted into the carbonate by boiling.

Dose.—H. & C., ℥ ss.-i. (15.-30.); Sh. & Sw., ʒ ss.-i. (2.-4.); D., gr.v.-xx. (.3-1.3).

Preferable to carbonate for internal use, as it is less irritating.

Potassii Acetas. Potassium Acetate. $KC_2H_3O_2$. (U. S. & B. P.)

Synonym.—Terra foliata tartari, E.; Essigsaures kali, G.

Derivation.—Add acetic acid in excess to potassium carbonate. Evaporate to dryness and fuse residue.

$$K_2CO_3 + 2\ HC_2H_3O_2 = 2\ KC_2H_3O_2 + H_2O + CO_2.$$

Properties.—A white powder, or crystalline masses of a satiny

lustre; odorless and having a warming, saline taste. Very deliquescent on exposure to the air. Soluble in 0.4 part of water and in 2 parts of alcohol.

Dose.—Same as bicarbonate.

Potassii Citras. Potassium Citrate. $K_3C_6H_5O_7$. (U. S. & B. P.)

Synonym.—Citrate de potasse, Fr.; Citronsaures kali, G.

Derivation.—Neutralize potassium carbonate with a solution of citric acid, and evaporate to dryness.

$$3\ K_2CO_3 + 2\ H_3C_6H_5O_7 = 2\ K_3C_6H_5O_7 + 3\ H_2O + 3\ CO_2.$$

Properties.—Transparent, prismatic crystals, or a white, granular powder; odorless and having a cooling, saline taste. Deliquescent on exposure to air. Soluble in 0.5 part of water; sparingly soluble in alcohol.

Dose.—Same as bicarbonate.

ACTION OF THE CARBONATES AND VEGETABLE SALTS.

The carbonate is too irritating for internal use, while the bicarbonate is more so than the similar sodium salt. Therefore the latter is in more common use as an antacid. Antacids neutralize abnormal gastric acidity if given some time after eating in large doses.

The vegetable salts (the acetate and citrate) are converted into the carbonate in the blood and are non-irritating. The bicarbonate is also absorbed into the blood as the carbonate. These salts, together with the hydrate, alkalize the blood and urine. It is thought by many authorities that they increase oxidation within the body, as it is known that they do so outside the body in contact with organic matter. As a result of all experiments with the hydrates and carbonates, neither oxidation nor metabolism appear to be materially influenced.

Uric acid elimination is not affected, but urea may be increased, replacing ammonia in the urine. The action of these salts is due wholly to the hydroxyl (OH) ion. The action of the carbonates is only less in degree and rapidity than the hydrates, since OH is freed in the body when carbonates combine with water. The carbonates are mainly useful as antacids; the citrate and acetate as diuretics.

Uses.—Potassium carbonate forms a useful addition to mixtures for application to the skin, as, through its strong alkalinity, it removes grease and sebaceous matter, permitting medicinal agents to

penetrate the skin. A mixture of potassium carbonate, 15.0 (℥ss.); sublimed sulphur, 50.0 (℥i. ℥v.); and water, 12 litres (3 gallons), makes a serviceable application for the milder forms of mange and eczema. The animal should be well washed with the mixture in a tub every second day, and peruvian balsam, oil of cade or tar should be applied daily. Potassium bicarbonate in aqueous solution is serviceable in relieving itching (gr. v.-℥i.) While probably not so generally efficient as the corresponding sodium salt, it is of benefit when given an hour after feeding to horses subject to colic at that time. It is more useful than sodium bicarbonate in alkalizing an over-acid urine (dogs), and in dissolving and eliminating uric acid from the blood. Potassium citrate and acetate are indicated in irritation or inflammation of the kidneys and bladder and cause absorption of exudations (pleural effusions, for example), through their diuretic power. They are sometimes prescribed in fever on account of slight diaphoretic and powerful diuretic properties.

Potassium acetate and citrate stimulate bronchial secretion and make it thinner, and are recommended accordingly in bronchitis. They are less efficient than potassium iodide for these purposes in this affection.

Potassii Nitras. Potassium Nitrate. KNO_3 (U. S. & B. P.)

Synonym.—Nitre, saltpetre, E.; nitre prismatique, azotate (nitrate) de potasse, Fr.; saltpetersaures kali, kalisalpeter, G.

Derivation.—Saltpetre is formed in the soil in certain regions and climates and is made artificially, by the putrefaction of animal or vegetable material, in the presence of heat, moisture, oxygen, and alkaline or earthy bases capable of fixing the nitric acid set free in this process, known as nitrification. The natural conditions for nitrification are present in some parts of India, and saltpetre is largely imported from Calcutta. Artificially, nitre beds are made of animal and vegetable matter, wood ashes, and calcareous earth or old plaster from houses. Sodium nitrate is imported extensively from Chili, where it occurs as a mineral product, and is used widely in this country in artificial fertilizers. Chili saltpetre may be converted into nitre by treatment with potash.

Properties.—Colorless, transparent, six-sided, rhombic prisms, or a crystalline powder, odorless and having a cooling, saline and pungent taste. Permanent in the air. Soluble in 3.6 parts of water; very sparingly soluble in alcohol.

Dose.—H. & C., ℥ ss.-i. (15.-30.); Sh. & Sw., ℥ ss.-i. (2.-4.); D., gr.v.-xx. (.3-1.3).

Action External.—Refrigerant.

Action Internal.—Stomach and Intestines.—Nitre causes, in lethal doses, violent gastro-enteritis, often nephritis, muscular weakness, coma, collapse and depression of the circulation. The pulse becomes both slow and weak. There is muscular weakness and paralysis. Potassium nitrate is one of the most irritating salts of this group, but its toxic effect depends upon the influence of the nitrate ion, and—when concentrated—upon its "salt action" (see p. 133) in withdrawing water from the tissues.

Blood.—Toxic doses of nitre have a slight decomposing action (hemolysis) on the blood.

Heart.—Nitre is said to be more depressing to the heart than the other potassium compounds. There is no basis for this belief.

Lungs.—The respiration is slowed by considerable doses of potassium nitrate, and it exerts an antispasmodic action by depression of the unstriped fibres of the bronchi.

Kidneys.—Diuresis is the predominant medicinal action of nitre. It may induce diuresis through its "salt action" (see p. 134) but in that case should escape unchanged in the urine. Apparently little or none is thus eliminated, except after large doses. In moderate doses the salt is changed in the body. It is conjectured that it is first converted into nitrates, then into ammonia, and finally escapes from the lungs as free nitrogen.

The diuretic action is chiefly due to direct stimulation of the renal cells.

Potassium nitrate is more frequently prescribed than any other potassium salt in veterinary practice, and is commonly considered one of the best febrifuges. Its only service in fevers is as a diuretic. Its use as a febrifuge has therefore been long abandoned in human medicine.

Administration.—Nitre is dissolved in a pail of drinking water and kept constantly at the larger animal's disposal. The salt is rendered harmless by dilution; vascular tension and diuresis are increased by the water, and the solution is cooling and grateful to the taste in fever. Smaller doses (℥ ss.) may be given on the food to horses.

Uses.—Nitre, ammonium chloride, and common salt, each one part, are dissolved in three parts water, and sometimes used for their refrigerant effect on local inflammatory conditions. Ice poultices are more efficient. The value of nitre is over-estimated in veterinary practice. It is recommended in purpura and rheumatism as an alterative. Here again it is less serviceable than ergot in the former, or salicylic acid and alkalies in the latter disease. Nitre is, however,

in common use in such febrile affections as pneumonia and influenza in horses.

Powdered potassium nitrate—mixed with an equal amount of stramonium leaves—is sometimes employed in asthma and bronchitis of dogs as an inhalation by burning the mixture.

Potassii Chloras. Potassium Chlorate. $KClO_3$. (U. S. & B. P.)

Synonym.—Kali oxymuriaticum, E.; chlorate de potasse, Fr.; chlorsaures kali, G.

Derivation.—Pass chlorine into a mixture of potassium carbonate and calcium hydrate; dissolve the result in boiling water and recover the chlorate by crystallization.

$K_2CO_3 + 6\ Ca\ (OH)_2 + 12\ Cl = 2\ KClO_3 + Ca\ CO_3 + 5\ Ca\ Cl_2 + 6\ H_2O$.

Properties.—Colorless, lustrous, monoclinic prisms or plates, or a white powder, odorless, and having a cooling, saline taste. Permanent in the air. Soluble in 16 parts of water. Insoluble in absolute alcohol, but slightly soluble in mixtures of alcohol and water. Explodes readily when rubbed with sugar, sulphur, charcoal, glycerin and many other substances.

Dose.—H. & C., 3 ii.-vi. (8.-24.); Sh. & Sw., 3 ss.-i. (2.-4.); D., gr. v.-xx. (.3-1.3).

Action Internal.—Stomach and Bowels.—In concentrated form potassium chlorate is an irritant to mucous membranes—causing vomiting and purging in the alimentary tract—owing to its withdrawal of water from the tissues. Its "salt action" is also seen in its increasing tension in the renal glomeruli and thus causing diuresis (see p. 134, sodium chloride). Lethal doses occasion gastro-enteritis, diarrhea, cyanosis, depression of the heart, coma and death from asphyxia. Jaundice and dark-colored urine occur in sub-acute poisoning.

The Blood.—The blood is unaffected by medicinal doses, but in poisoning the red corpuscles are broken down and crenated. The hemoglobin is converted into methemoglobin, which is probably a mixture of hematin and soluble albumin. Hemoglobin, methemoglobin and hematin and disintegrated corpuscles appear in the urine. The blood is chocolate-colored after death. The liver, spleen, kidneys and intestines are softened and filled with disorganized blood. It was formerly thought that potassium chlorate parted with its oxygen in the blood, and it was prescribed in many disorders as an

oxidizing agent. Potassium chlorate gives up very little oxygen to the body since almost all of the salt absorbed escapes unchanged from the organism. On the contrary, the important symptoms of poisoning are due to lack of oxygen (asphyxia), methemoglobin not liberating its oxygen readily to the tissues. Death from fat embolism is not uncommon during convalescence from poisoning.

Elimination.—Potassium chlorate is eliminated unchanged by all channels; mainly by the urine (90 to 96 per cent.), but also by the sweat, saliva, etc. Acting locally as a stimulant in the mouth, and then affecting the throat a second time by its elimination in the saliva, potassium chlorate is frequently prescribed in diseases of the mouth and pharynx as a topical stimulant. It is given in electuary, solution, or ball internally.

Summary.—Sialogogue and diuretic.

Uses.—Stomatitis is treated by chlorate of potassium in saturated solution applied on a swab. The salt is valuable in the treatment of pharyngitis in electuary. A favorite combination consists of fluidextract of belladonna, ℥i.; potassium chlorate, ℥ii.; powdered licorice root, ℥v., with sufficient molasses to make an electuary. One ounce is to be smeared on the teeth of a horse thrice daily.* An half ounce of a saturated solution of potassium chlorate, with a few drops of laudanum, forms a useful injection for hemorrhoids in dogs.

Potassii Bitartras. Potassium Bitartrate. $KH_4C_4HO_6$. (U. S. P.)

Synonym.—Potassii tartras acida, B.P.; cream of tartar, cremor tartari, acid tartrate of potash, E.; tartarus depuratus, P. G.; pierre de vin, Fr., weinstein, G.

Derivation.—Obtained from crude tartar (argol) deposited on the sides of wine casks during fermentation of grape juice, by purification.

Properties.—Colorless or slightly opaque, rhombic crystals, or a white, somewhat gritty powder; odorless and having a pleasant, acidulous taste. Permanent in the air. Soluble in about 200 parts of water; very sparingly soluble in alcohol. Reaction acid.

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* Also in membranous croup (roup) of fowl (gr.x.), and in that of foals, calves and pigs (gr. xxx.), it is useful when given in solution with an equal dose of the tincture of chloride of iron.

Dose.—H. & C., ℥ ss.-i. (15.-30.); Sh. & Sw., ℥ ss. (15.); D., ʒ ss.-i. (2.-4.).

Action internal.—Intestines.—Potassium bitartrate is a non-irritating purgative in large doses. It is a hydragogue cathartic and has a strong affinity for water; abstracting it from the blood vessels in the bowels, holding the same in solution, and thus flushing out the intestines. (See p. 131.)

Blood.—Potassium bitartrate is in part decomposed, converted into the carbonate, and absorbed as such into the blood. The greater part is apparently excreted by the bowels unchanged. A portion of the latter, however, may have been absorbed and eliminated by the intestines.

Kidneys.—Potassium bitartrate is an active diuretic and renders the urine more alkaline, but for some reason it is not ordinarily employed in veterinary practice. Nevertheless, it is the best and safest diuretic which can be used by the veterinarian in the treatment of the horse and smaller animals.

Summary.—Diuretic in small doses. Hydragogue cathartic in large doses. It should be given in solution and is useful in dropsies, more particularly of renal origin; also in catarrhal jaundice, and as a laxative for foals and calves. In cases where the urine of the horse is thick, stringy and high-colored, potassium bitartrate will cause it to regain its normal state. It may easily be administered in either food or drinking water, and its diuretic effect is enhanced when the salt is given with a large amount of water.

Sodium.

(*The metal is not employed in medicine.*)

Sodii Hydroxidum. Sodium Hydroxide. NaOH. (U. S. P.)

Synonym.—Soda caustica, B.P.; soda, sodium hydrate, caustic soda, natrum causticum, S. hydricum, E.; soude caustique, Fr.; natron ætznatron, G.

Derivation.—It is made from liquor sodæ by evaporation, and run in moulds.

Properties.—Dry, white, translucent pencils, or fused masses, showing a crystalline fracture; odorless, and having an acrid and caustic taste. Exposed to the air it rapidly deliquesces, absorbs carbon dioxide, and becomes covered with a dry coating of carbonate. Soluble in 1 part of water; very soluble in alcohol.

Liquor Sodii Hydroxidi. Solution of Sodium Hydroxide. (U. S. & B. P.)

An aqueous solution of sodium hydroxide, containing about 5 per cent. of hydroxide.

Synonym.—Solution of sodium hydrate, E.; natrum hydricum solutum, soude caustique liquide, Fr.; liquor natri caustici, P. G.; ætznatron lauge, G.

Derivation.—An aqueous solution of sodium carbonate is boiled with calcium hydrate, and the supernatant liquid is siphoned off.

$$Na_2CO_3 + Ca(OH)_2 = 2\ NaOH + CaCO_3.$$

Properties.—A clear, colorless liquid, odorless, having a very acrid and caustic taste, and a strongly alkaline reaction.

Dose.—H. & C., ʒ ss.-i. (15.-30.); Sh. & Sw., 3 ss.-i. (2.-4.); D., ♏ v.-xx. (.3-1.3).

Action and Uses.—Sodium hydroxide and its solution resemble compounds of potassium, but are used chiefly for chemical and pharmaceutical purposes.

Liquor sodii hydroxidi should be given largely diluted with water. In poisoning by the caustic alkalies or soap lye, give vinegar, diluted acetic acid, lemon juice and demulcents. Inject subcutaneously camphorated oil (H. & C., ʒ ss.-i.; D., ♏ xv.-xx.).

Sodii Carbonas. Sodium Carbonate. $Na_2\ CO_3\ 10\ H_2O$. (U. S. & B. P.)

Synonym.—Washing soda, sal soda, carbonas sodicus, E.; natrum carbonicum crudum, P. G.: carbonate de soude, Fr.; kohlensaures natron, soda, G.

Derivation.—Made by Leblanc's process. Three steps:

1st. Salt and sulphuric acid heated together. $2\ Na\ Cl + H_2\ SO_4 = Na_2\ SO_4 + 2\ HCl$.

2nd. Sodium sulphate is heated with carbon. $Na_2SO_4 + 4\ C = Na_2\ S + 4\ CO$.

3rd. Sodium sulphide heated with chalk. $Na_2\ S + Ca\ CO_3 = Na_2\ CO_3 + Ca\ S$.

Properties.—Colorless, monoclinic crystals, odorless and having a strongly alkaline taste. In dry air the salt effloresces, loses about half its water of crystallization and becomes a white powder. Soluble in 1.6 parts of water and in 1.02 parts of glycerin. Reaction alkaline.

Sodii Carbonas Monohydratus. Monohydrated Sodium Carbonate.

$Na_2CO_3 + H_2O$. (U. S. & B. P.)

Synonym.—Natrum carbonicum siccum, P. G.; carbonate de soude, Fr.; getrocknete soda, G.

Properties.—A white, crystalline, granular powder, odorless and having a strongly alkaline taste. When exposed to the air, under ordinary conditions, it absorbs only a slight percentage of moisture. Soluble in 2.9 parts of water; insoluble in alcohol and ether; soluble in 8 parts of glycerin. Reaction alkaline. *Action of sodium carborate* similar to the hydroxide, but infrequently employed in medicine.

Dose.—H. & C., ʒ ii.-vi. (8.-24.); Sh. & Sw., gr.xx.-xl. (1.3-2.6); D., gr.v.-xx. (.3-1.3). Given in large amount of water.

Sodii Bicarbonas. Sodium Bicarbonate. $Na\,HCO_3$. (U. S. & B. P.)

Synonym.—Soda, baking soda, sodium sesquicarbonate, natrum carbonicum acidulum, bicarbonas sodicus, sodium hydrocarbonate, bicarbonate of soda, E.; natrum bicarbonicum, P. G.; bicarbonate de soude, sel digestive de vichy, Fr.; doppelkohlensaures natron, G.

Derivation.—Pass CO_2 through a solution of sodium carbonate, $Na_2\,CO_3 + CO_2 + H_2O = 2\,Na\,HCO_3$.

Properties.—A white, opaque powder, odorless, and having a cooling, mildly alkaline taste. Permanent in dry, but slowly decomposed in moist air. Soluble in 12 parts of water, insoluble in alcohol and ether. Slight alkaline reaction.

Incompatibles.—Decomposed by acid and acid salts, as bismuth subnitrate.

Dose.—H., ʒ ss.-ii. (15.-60.); Sh. & Sw., ʒ ss.-i. (2.-4.); D., gr.v.-xxx. (.3-2.).

General Action of Sodium Salts.

Sodium and its salts are said to be less poisonous than the corresponding salts of potassium because they are less depressing to the circulatory (see p. 117), muscular and nervous systems, but death has occurred after enormous doses. The salts possess a local paralyzing action on nerve and muscular tissue. They are absorbed and eliminated more slowly than the corresponding potassium

compounds. Sodium salts alkalize the blood and urine, but are only slightly diuretic. Sodium carbonate, phosphate, and sulphate diminish the solids in the bile and, therefore, increase its fluidity.

Sodium Bicarbonate.

Action External.—Sodium bicarbonate lessens irritability of the skin in itching and burns.

Action Internal.—When sodium bicarbonate is given internally it counteracts gastric acidity, whether it be normal or excessive (hyperchlorhydria). Its constant administration weakens the digestive powers and creates anemia, general cachexia, and scorbutic symptoms. Sodium bicarbonate liberates carbonic dioxide in the stomach, which is a sedative and peristaltic stimulant, thus expelling gas and relieving pain in the viscus. The CO_2 thus set free slightly offsets the action of sodium bicarbonate in lessening acidity since CO_2 excites HCl secretion during gastric digestion. Soda dissolves mucus and thins the biliary secretion. It is, therefore, useful in catarrh of the gastro-intestinal tract.

Blood.—The blood is made more alkaline.

Kidneys.—The urine is alkalized, but the salt is only feebly diuretic ("salt action," p. 133).

Uses External.—In aqueous solution (1-50) sodium bicarbonate relieves itching in urticaria, prurigo and chronic eczema. It dissolves mucus in leucorrhea and is often used in this strength as a vaginal injection. It also allays the pain of slight burns and of acute rheumatism. For this purpose cloths should be soaked in saturated solutions and placed upon the affected parts. Added to water (℥i.-Oi.) in which instruments are to be boiled, it prevents rusting.

Uses Internal.—Sodium bicarbonate is one of the most useful remedies in gastric or intestinal indigestion associated with abnormal acidity, or flatulence and distress. It does not always remove the cause of indigestion, however, and, therefore, should be combined with agents which do: *e.g.,* cathartics, antiseptics, carminatives and stomachics. For this reason sodium bicarbonate is often prescribed to dogs with bismuth subcarbonate, salol or beta naphtol; to horses with gentian or nux vomica and ginger. Two drams of sodium bicarbonate with half a dram of bismuth subnitrate may be given thrice daily in indigestion and diarrhea of calves, especially when the trouble has arisen from feeding sour milk.

Sodium bicarbonate is of value in alkalizing the blood in acute

rheumatism. In threatened coma in diabetes mellitus large doses of the salt given in solution by the mouth or intravenously, neutralize diacetic acid in the blood and may avert a fatal ending.

Sodium bicarbonate is of much worth in alkalizing the urine and in preventing the formation of calculi so often occurring in stall-fed cattle, rams and wethers and may be placed on the feed or in the drinking water. The salt is supposed to assist the action of calomel, with which it is often conjoined to stimulate the flow of bile and aid the alkaline intestinal juices in transforming the inactive chloride into the active oxide (see p. 204). Sodium bicarbonate is occasionally given in acute bronchitis, but it is distinctly inferior to the corresponding potassium salt in thinning and increasing bronchial secretions.

This salt is highly recommended in the treatment of hemoglobinemia (azoturia) in horses when given in quantities of 10-30 ounces daily. Theoretically, sodium bicarbonate is of benefit in this disease, by neutralizing acid products of metabolism which lead to solution of the hemoglobin. Sodium bicarbonate relieves thirst in polyuria of horses, when placed in their drinking water.

Administration.—Sodium bicarbonate may be given in solution, or on the tongue or food in the pure state.

Sodii Sulphas. Sodium Sulphate. $Na_2\ SO_4\ 10H_2O$. (U. S. & B. P.)

Synonym.—Glauber's salts, sulfas sodicus (natricus) sal mirabile Glauberi, sulphate of soda, E.; sulfat de soude, sel de Glauber, Fr.; Glaubersalz, G.

Derivation.—Neutralize the residue left in the manufacture of HCl from salt, with sodium carbonate. $2\ Na\ HSO_4 + Na_2\ CO_3 = 2\ Na_2SO_4 + CO_2 + H_2O$.

Properties.—Large, colorless, transparent, monoclinic prisms, or granular crystals, odorless, and having a bitter, saline taste. The salt effloresces rapidly in the air, and finally loses all its water of crystallization. Soluble in 2.8 parts of water; insoluble in alcohol; soluble in glycerin.

Dose.—C., ℔i-ss. (500.-750.); H. (laxative), ℥ ii.-iv. (60.-120.); Sh., ℥ ii.-iv. (60.-120.).

Action Internal.—Digestive Tract.—The action of the saline cathartics depends upon the slow absorption of certain acid ions or anions (sulphates, phosphates, tartrates, and citrates) as compared with others (chlorides, bromides, and iodides). The latter, being readily absorbed into the blood, cause diuresis. The former salts

fail of absorption—to any considerable extent—in the bowel, and so their solutions increase the fluidity of the ingesta and aid in the expulsion of feces. Peristaltic action is also excited through increase of the mass of intestinal contents.

Concentrated (hypertonic) solutions of the saline purgatives withdraw water from the blood-vessels of the bowels because the solution in the intestines has a greater osmotic pressure than the blood. When the solution in the bowel becomes sufficiently diluted to be isotonic with the blood some absorption and diuresis occurs ("salt action," see p. 134).

The blood and urine first become concentrated, and thirst is induced by the action of the saline purgatives in both withdrawing water from the blood and in preventing absorption of water from the digestive tract.

Later diuresis may take place, especially when absorption of the saline occurs through failure of purgation.

The basic ion, or kation, of some salts is less absorbable than that of others (as Mg), and when such a basic ion is combined with an acid ion of slow absorption (as in $MgSO_4$) the purgative effect is naturally at its maximum.

Any cholagogue action, formerly attributed to the saline purgatives, has been proved to be wanting. The saline cathartics are sometimes called hydragogues.

Uses Internal.—Sodium sulphate is not used much in human practice on account of its nauseating taste and it is said to produce more griping. For the larger animals it is sometimes preferred to the magnesium salt in veterinary medicine, although Epsom salt is in more common use. Sodium sulphate is the principal ingredient of Carlsbad salts, which have recently come into vogue with veterinarians, although long valued in human medicine. The formula for the artificial Carlsbad salts (*Sal carolinum factitium*), which is the preparation commonly used, is as follows:

℞ Sodii sulphatis exsiccati..... 40.0
Sodii bicarbonatis..... 35.0
Sodii chloridi..... 15.0
Potassii sulphatis..... 2.0
M. et fiat pulvis.
Sig. One to two heaping tablespoonfuls on the food two or three times daily for horses.

Sodium sulphate is thus given as Carlsbad salts or alone in small doses as a laxative, but in constipation associated with indigestion and malnutrition, gentian, powdered rhubarb, iron and

other stomachics and tonics are often combined; while, in fever, small doses of Glauber's salts are useful in promoting the activity of the skin and kidneys, and for this purpose may be given with spirit of nitrous ether, to which diluted sulphuric acid and the compound tincture of gentian may be added to improve appetite and digestion. Glauber's salts are useful in aiding the action of peristaltic agents, as aloes. Small doses are given to horses in their drinking water while the aloes is acting.

Sodium sulphate is of benefit in the treatment of diarrhea, dysentery and overloaded and impacted colon of horses when given in frequent and repeated doses in connection with linseed oil.

An enema, consisting of one pound of Glauber's salts in a quart of water, to which two ounces of oil of turpentine and four ounces of glycerin may with advantage be added, should be injected high into the bowel to secure rapid purgation in horses suffering with colic.

Glauber's and Epsom salts are the most common purgatives given to ruminants. It is therefore impossible to enumerate special indications for their employment in the case of these animals. To assist the action, one teaspoonful each of ginger and molasses are given with each ounce of Glauber's or Epsom salts, and often an equal weight of sodium chloride. When a speedy action is desired, Glauber's salts should be administered with a large amount of water and thirst should be encouraged by the addition of common salt. When, on the other hand, it is essential to remove fluid and morbid effusions from the body, the purgative salt should be exhibited in concentration and the patient should be deprived of water to a considerable extent. Glauber's and Epsom salts are not used so commonly in canine practice as calomel and castor oil, but find more favor with German than English-speaking veterinarians.

Sometimes salts are serviceable in irritable states of the bowels in dogs (piles, duodenitis and intestinal catarrh) in teaspoonful doses; and when given every second day, as a laxative, in eczema. Vomiting, however, not uncommonly follows the ingestion of salts by dogs.

Carlsbad salts form a good cathartic for cage birds. About 3 grains are added to an ounce of their drinking water in the case of small birds.

Sodii Chloridum. Sodium Chloride. NaCl.
(U. S. & B. P.)

Synonym.—Common or table salt, muriate of soda, sal commune or culinare, chloruretum sodicum, E.; natrium chloratum

purum, P. G.; chlorure de sodium, sel commun, sel de cuisine, Fr.; chlornatrium, kochsalz, G.

Derivation.—Mined in a native state and obtained by evaporation of brine, spring or sea water.

Properties.—Colorless, transparent, cubical crystals, or a white, crystalline powder, odorless, and having a purely saline taste. Permanent in dry air. Soluble in 2.8 parts of water; almost insoluble in alcohol; insoluble in ether or chloroform. Reaction neutral.

Dose.—Cathartic, C., ℔ss.-i. (250.-500.); Sh., ʒ i.-ii. (30.-60.).

Action External.—Salt is a stimulant to the skin when applied in concentrated solution.

Action Internal.—Salt is an essential constituent of food necessary to the composition of HCl in the gastric juice, and of blood plasma, from which it is constantly eliminated in the urine. Herbivorous animals require sodium chloride in addition to that contained in their food; for blood is rich in common salt, while vegetables abound more especially in potassium salts. The potassium salts, according to Bunge, on entering the blood bring about a chemical reaction, whereby sodium chloride circulating in the plasma is split; the chlorine in sodium chloride combines with potassium, while the acid, set free from the potassium salt unites with sodium, and both products are swept away with the urine, thus removing sodium chloride from the blood. This is only replaced by that taken as food.* Animals deprived of salt suffer from anemia, general weakness and edema.

Stomach and Intestines.—Salt has caused gastro-enteritis and death in enormous doses. Large doses occasion emesis in dogs. Irritation of the stomach is caused by withdrawal of water from the mucous membranes by strong (hypertonic) solutions (osmotic action). This is called "salt action" and is common to all salts of the alkalies. Salt in the food often improves digestion—probably by bettering the taste of the food and exciting the appetite and so, reflexly, stimulating the flow of gastric juice, on the same principle that the sight, taste, and smell of food are the chief factors in the first secretion of HCl. Salt acts in the bowels as a mild hydragogue purgative. It is unfit as a cathartic for horses or dogs; but is useful for cattle and sheep when combined with magnesium or sodium sulphate. Salt creates thirst and, therefore, promotes the ingestion of water. A large supply of water flushes the system

* Some doubt is cast upon this hypothesis by Lapicque, who relates that African tribes, living wholly upon vegetables, use wood ashes (chiefly potassium) in place of table salt.

and removes deleterious and imperfectly oxidized matters. Neither salt nor any of the sodium salts are as diuretic as the potassium salts.

Salines generally, on being absorbed into the blood, increase its concentration, which causes a flow of water into the blood and increases its volume. This leads to enhanced vascular tension and so to diuresis.

In the case of sodium salts, however, elimination is so rapid from the blood that they do not have time to attract water and occasion diuresis as do potassium salts. When an electrolyte is introduced into the blood it may either act through its ions (p. 3) or, if these are inert, by "salt action." This is practically osmosis.

If a salt is introduced into the blood, water will be drawn into the vessels from the surrounding tissues until the concentration of the salt in the blood is equal to that outside the vessels, or until the blood is isotonic with the surrounding fluid.

Hence a normal salt solution for injection into the blood is also said to be isotonic or equal in concentration to that normally in the blood.

Blood.—The red corpuscles are augmented by salt.

Metabolism.—Salt solutions in the blood withdraw fluid lymph from the tissues by osmotic action. In this way they appear to stimulate tissue change, as there is an increased elimination of nitrogen in the urine. Vascular tension is thus augmented and activity of the malpighian bodies, and therefore diuresis results. This is another example of "salt action" and is common to the other salts of the alkalies.

Summary.—Emetic, cathartic, digestive, slight diuretic.

Uses External.—A solution consisting of one ounce each of salt, nitre and sal ammoniac, in one quart of water, may be used on bruises and sprains as a stimulant and refrigerant lotion. Severe hemorrhage, collapse and surgical shock are treated most successfully by injections of hot normal salt solution into a vein, under the skin, or into the rectum. The solution maintains the proper salinity of the blood, replaces the mass of blood lost, and supplies heat. The solution is made by adding one heaping teaspoonful of salt to a quart of boiled water at a temperature of 100° to 105° F. (See p. 655.) Salt is an efficient antidote externally and internally to silver nitrate.

Uses Internal.—Salt is a serviceable emetic for dogs, when zinc sulphate is not at hand, in emergencies and poisoning. One teaspoonful may be stirred into a cup of lukewarm water with a tablespoonful of mustard. It is a useful addition to Epsom salts, since it increases thirst and the ingestion of water, and assists purgation

in overloaded conditions of the first and third stomachs of ruminants. One-half pound of salt is administered to cattle with one-half to one pound of Epsom salts, one-quarter pound of ginger and a pint of molasses in two quarts of water. The habitual ingestion of salt is prejudicial to ascarides and diminishes the secretion of mucus in which they live. It is even more efficacious in destroying oxyurides inhabiting the lower bowels. Enemata containing 1 to 2 tablespoonfuls of salt to the pint of water are employed for this purpose. Salt should be constantly kept in the feed boxes of horses and cattle.

Animals convalescing from acute diseases, and those with feeble digestion, need salt particularly. Horses are commonly given a bran mash once a week, with plenty of salt to enhance its laxative and hygienic action. Dogs usually procure sufficient salt in their ordinary food, but it should be added to their diet in the treatment of obesity. Salt increases edemas and dropsies and should be excluded from the diet in chronic nephritis, in chronic heart disease with edema, in ascites, in pleuritic effusions and hydrothorax—notwithstanding that formerly it was taught that salt aided the absorption of pleural effusions.

Sodii Phosphas. Sodium Phosphate. $Na_2HPO_4 + 12\ H_2O$. (U. S. & B. P.)

Synonym.—Phosphas sodicus (atricus), sal mirabile, perlatum, phosphate of soda, E.; natrum phosphoricum, P. G.; phosphate de soude, Fr.; phosphorsaures natrum, G.

Derivation.—Digest bone ash with sulphuric acid. $Ca_3\ 2PO_4 + 2\ H_2\ SO_4 = Ca\ H_4\ 2\ PO_4$ (acid calcium phosphate) $+ 2\ Ca\ SO_4$. Filter and add sodium carbonate to filtrate.

$Ca\ H_4\ 2\ PO_4 + Na_2\ CO_3 = Na_2H\ PO_4 + H_2O + CO + Ca\ HPO_4$. Evaporate, and sodium phosphate crystallizes out.

Properties.—Large, colorless, monoclinic prisms, odorless, and having a cooling, saline taste. The crystals effloresce in the dry air and gradually lose 5 molecules of their water of crystallization. Soluble in .5 parts of water; insoluble in alcohol; slightly alkaline reaction.

Dose.—Same as sodium sulphate; D., 3 i.-ii. (4.-8.) as laxative.

The phosphate resembles the sulphate, but is a milder purgative and is wrongly thought to be an hepatic stimulant. It is indicated in jaundice due to duodenitis, and as a laxative for foals and calves. It is occasionally prescribed in rickets as a source of phosphorus, but the calcium phosphate is more appropriate.

Sodii Sulphis. Sodium Sulphite. $Na_2 SO_3 7 H_2O$. (U. S. & B. P.)

Synonym.—Natrum sulfuriosum, sulfis sodicus (natricus), sulphite of soda, E.; sulfite de soude, Fr.; schwefligsaures natron, G.

Derivation.—Saturate a solution of sodium carbonate or hydrate with sulphurous anhydride gas. $Na_2 CO_3 + SO_2 = Na_2SO_3 + Co_2$.

Properties.—Colorless, transparent, monoclinic prisms, odorless, and having a cooling, saline, sulphurous taste. In air the salt effloresces, and is slowly oxidized to sulphate. Soluble in 2 parts of water; sparingly soluble in alcohol; neutral or feebly alkaline.

Dose.—H. & C., ʒi. (30.); Sh. & Sw., ʒss.-i. (2.-4.); D., gr.v.-xxx. (.3-2.).

Sodii Bisulphis. Sodium Bisulphite. $NaHSO_3$. (U. S. P.)

Derivation.—Obtained from sodium carbonate or bicarbonate and sulphurous anhydride gas.

Properties.—Opaque, prismatic crystals, or a granular powder, exhaling an odor of sulphur dioxide and having a disagreeable, sulphurous taste. Exposed to the air the salt loses sulphur dioxide and is gradually oxidized to sulphate. Soluble in 4 parts of water and in 72 parts of alcohol; reaction acid.

Dose.—Same as sodium sulphite.

Sodii Thiosulphas. Sodium Thiosulphate. $Na_2S_2O_3 5 H_2O$. (U. S. P.)

Synonym.—Sodium hyposulphite, hyposulphate of soda, E.; natrum subsulfurosum (hyposulfurosum), P. G.; hyposulphis sodicus, hyposulfite de soude, sulfite solfuré de soude, Fr.; unter schwes fligsaures natron, G.

Derivation.—Dissolve sulphur in a boiling aqueous solution of sodium sulphite.

Properties.—Colorless, transparent, monoclinic prisms, odorless, and having cooling, afterwards bitter, taste. Permanent in air below 33° C. (91.4° F.), but efflorescent in dry air above that temperature. Soluble in 0.35 part of water; insoluble in alcohol; slightly soluble in oil of turpentine; reaction neutral.

Dose.—Same as sodium sulphite.

Administration.—The sulphites are given in solution, or may be added in powder to the food of horses.

ACTION OF THE SULPHITES, BISULPHITES AND HYPOSULPHITES.

Action External.—These salts are antiseptics, deodorizers and parasiticides externally and in the digestive tract. The antiseptic action is due to the destructive effect of the sulphites in withdrawing oxygen from organic matter to oxidize themselves into sulphates. Given internally, 96 per cent. of sodium sulphite escapes in the urine as a sulphate, while but 3 per cent. is eliminated unchanged. It has been taught that the sulphites are converted into sulphur dioxide (SO_2) by the acids in the stomach, but this is very doubtful.

Uses.—A 15 per cent. solution or ointment of the sulphites are used against pruritus and parasitic skin diseases. The salts are recommended in indigestion with fermentation, flatulence and foul-smelling feces and in general septic conditions, but have proved as useless as most other drugs in the latter states. Sternberg found that neither the sulphites nor hyposulphites exerted any germicidal action on bacteria in culture media.

The other sodium salts are of no particular value in veterinary practice except sodium bromide. (See Bromine, p. 222.)

Ammonium.*

Ammonium is not employed in medicine. Ammonia (NH_3) exists in the free state as a gas, and is used in medicine in solution in water or alcohol.

Aqua Ammoniæ. Ammonia Water. (U. S. P.)

Synonym.—Liquor ammoniæ, B. P.; spirits of hartshorn, E.; liquor ammonii caustici, P. G.; spiritus salis ammoniaci causticus, ammonia aqua soluta, ammoniaque liquide, eau (solution, liqueur) d'ammoniaque, Fr.; salmaikgeist, ætzammoniak, ammoniakflüssigkeit, G. An aqueous solution of ammonia (NH_3), containing 10 per cent., by weight, of the gas.

Properties.—A colorless, transparent liquid, having a very

* The radical Ammonium (NH_4) of the Ammonium compounds is not a metal although it resembles so closely—in physical, chemical, and physiological properties—the other alkaline metals, that it is usually classed with them.

pungent odor, an acrid, alkaline taste, and a strongly alkaline reaction. Spec. gr. 0.960.

Derivation.—Evolve ammonia gas by heating ammonium chloride with calcium hydrate, and pass it into water.

$2\ NH_4\ Cl + Ca(OH)_2 = 2NH_3 + 2\ H_2O + Ca\ Cl_2$.

Dose.—H & C., ℥ ss.-i. (15.-30.); Sh. & Sw., ʒi.-ii. (4.-8.); D., ♏x.-xx. (.6-1.3).

PREPARATION.

Linimentum Ammoniæ. Ammonia Liniment. (U. S. & B. P.)
Ammonia water, 350; cottonseed oil, 570; alcohol, 50; oleic acid, 30. (U. S. P.)

Aqua Ammoniæ Fortior. Stronger Ammonia Water. (U. S. P.)

Synonym.—Liquor ammoniæ fortis, stronger solution of ammonia, B. P.; eau d'ammoniaque forte, Fr.; starker salmiakgeist, G.

An aqueous solution of ammonia (NH_3), containing 28 per cent. by weight of the gas.

Derivation.—Same as aqua ammoniæ.

Properties.—A colorless, transparent liquid, having an excessively pungent odor, a very acrid and alkaline taste, and a strongly alkaline reaction. Spec. gr. 0.897.

Dose.—H. & C., ʒ ii.-vi. (8.-24.); Sh. & Sw., ʒ i. (4.); D., ♏v.-x. (.3-.6).

PREPARATION.

Spiritus Ammoniæ. Spirit of Ammonia. (U. S. P.)

Synonym.—Spiritus ammoniaci caustici dyondii, ammoniated alcohol, E.; liquor ammoniæ caustici spirituosus, P. G.; alcoolé d'ammoniaque, liqueur d'ammoniaque vineuse, Fr.; weingeistige ammoniakflussigkeit, G.

An alcoholic solution of ammonia (NH_3), containing 10 per cent., by weight, of the gas.

Properties.—A colorless liquid, having a strong odor of ammonia, and a spec. gr. of about 0.808.

This preparation combines the stimulating properties of ammonia and alcohol.

Dose.—H. & C., ʒ ss.-i. (15.-30); Sh. & Sw., ʒ i.-ii. (4.-8.); D., ♏ x.-xx. (6.-1.3.)

AMMONIA PREPARATIONS.

Action External.—Ammonia is a powerful irritant in stronger solution, or gas. If it is applied for a sufficient time, hyperemia, vesication and sloughing ensue.

Action Internal.—Stomach.—If swallowed in concentrated solution death may take place instantaneously from edema and spasm of the glottis. Otherwise, more or less extensive inflammation of the alimentary canal will follow, according to the amount ingested. Diluted vinegar and lemon juice, together with the white of egg, or sweet oil, should be given as antidotes. Tracheotomy may be indicated, if there is glottic obstruction. Ammonia, in passing through the mouth, throat, gullet and stomach, reflexly stimulates the heart and respiration before absorption can occur.

Ammonia is an antacid in the stomach, but should not be employed in gastric irritability.

Respiratory Tract.—Inhalation of stronger ammonia through the nostrils causes reflex stimulation of the heart and respiration by irritation of the nasal branches of the fifth nerve. Care must be exercised to prevent inflammation of the air passages. Ammonia stimulates the respiratory centre when it is injected into the blood. Given under the skin in lethal doses, ammonia causes death by paralysis of the respiratory centres.

Circulation.—It is probable that ammonia only acts reflexly to stimulate the heart through irritation of the stomach when it is ingested. If given intravenously or subcutaneously, ammonia stimulates directly the heart muscle, and probably the accelerator and vasomotor centres, making the cardiac pulsations stronger and quicker and increasing vascular tension. Rarely the vagus centre is stimulated and the heart's action slowed. Lethal doses paralyze the cardiac muscle. Ammonia differs from alcohol in being more evanescent as a stimulant, in not affecting the brain nor metabolism, and in not acting as a food.

Blood.—The normal blood contains ammonia, which is supposed to aid in maintaining its fluidity. The action on the blood is unknown. Ammonia is thought to prevent coagulation of blood within the vessels in conditions favorable to thrombosis.

Nervous System.—An intravenous injection of a lethal dose of ammonia occasions tetanic convulsions in animals, owing to stimulation of the reflex and motor functions of the cord. Medicinal doses excite the spinal reflex and motor centres. When ammonia is applied directly to nerve tissue it excites in dilute solution, but para-

lyzes functional activity in concentration. The brain is unaffected by the therapeutic administration of ammonia.

Elimination.—Ammonia combines with acid in the stomach and is absorbed into the blood. Ammonia and its carbonate are oxidized in the body and transformed into urea, in which form ammonia compounds escape in the urine. Urea being *the* most active diuretic there is some augmented flow. The urine is, however, not alkalized as by the salts of the other alkaline metals.

Summary.—Heart and respiratory stimulant and antacid. Externally, rubefacient, vesicant, and escharotic.

Uses.—The indications for ammonia are closely in accord with its physiological actions.

Externally.—It is frequently used in stimulating liniments. One part each of water of ammonia and oil of turpentine, may be combined to advantage with 4 to 6 parts of camphor liniment. Ammonia water is one of the best remedies to relieve pain and antagonize the action of insect bites, as stings of bees and wasps. It should be applied directly to the poisoned part.

Internally.—Ammonia is indicated when rapid stimulation of the heart and respiration is desirable. In emergencies it may be given intravenously (aq. ammon. fort. 1; water, 4 parts); or by inhalation. It is serviceable in the treatment of prussic acid and aconite poisoning, syncope, collapse and shock following surgical operations; also in snake bites. The spirit of ammonia may be prescribed in fevers as a stimulant. Ammonia is inferior to ammonium carbonate or the aromatic spirit in the care of colic and tympanites.

Ammonii Carbonas. Ammonium Carbonate. NH_4HCO_3 $NH_4\ NH_2\ CO_2$. (U. S. & B. P.).

Synonym.—Volatile salt, sal volatile siccum, carbonas ammonicus, E.; ammonium carbonicum, P. G.; carbonate d'ammoniaque, alkali volatil concret, sel volatil d'Angleterre, Fr.; flüchtige, laugensalz, reines hirchhornsalz, kohlensäures ammonium, G.

Derivation.—A mixture of ammonium chloride or sulphate, and calcium carbonate, is sublimed and resublimed. Ammonium carbonate, so-called, is a mixture of ammonium carbonate and bicarbonate.

$4\ NH_4\ Cl + 2\ Ca\ Co_3 = NH_4\ HCO_3\ NH_4NH_2CO_2 + 2\ Ca\ Cl_2 + NH_3 + H_2O$.

Properties.—White, hard, translucent, striated masses, having a strongly ammoniacal odor without empyreuma, and a sharp saline taste. On exposure to the air the salt loses both ammonia and carbonic dioxide, becoming opaque, and is finally converted into friable,

porous lumps, or a white powder. Soluble in about 4 parts of water. Alcohol only dissolves the carbonate ($NH_4 NH_2 CO_2$).

Dose.—H., 3ii. (8); C., 3iii.-vi. (12.-24.); Sh. & Sw., gr. xv.-xl. (1.-2.6); D., gr.iii.-x (.2-.6); D., emetic, gr.xv. (1.).

PREPARATION.

Spiritus Ammoniæ Aromaticus. Aromatic Spirit of Ammonia. (U. S. & B. P.)

Synonym.—Sal volatile, alcoolat ammoniacal aromatique, Fr.; aromatischer ammoniakgeist, G.

Ammonium carbonate	34
Ammonia water	90
Oil of lemon	10
Oil of lavender flowers	1
Oil of nutmeg	1
Alcohol	700
Distilled water to make	1000

Properties.—A nearly colorless liquid when freshly prepared, but gradually acquiring a somewhat darker tint. It has a pungent, ammoniacal odor and taste. Spec. gr. 0.900.

Dose.—H. & C., ʒi.-ii. (30.-60.); Sh. & Sw., 3 ii.-iv. (8.15); D., 3 ss.-i. (2.-4.), well diluted.

The aromatic spirit of ammonia nearly resembles ammonium carbonate in action, but the alcohol and volatile oils add to the stimulant qualities of ammonia and ammonium carbonate.

Action Internal.—Ammonium carbonate is decomposed by acid in the stomach and escapes in the urine as urea. It stimulates gastric secretion, vascularity and motion, and also excites intestinal peristalsis. It is, therefore, a stomachic and carminative. It is also an antacid, and, in large doses, an emetic to dogs. The action of ammonium carbonate is almost identical with that of ammonia water in stimulating the heart and respiration, but it has more power in augmenting the bronchial secretions.

Summary.—Cardiac and respiratory stimulant, expectorant, stomachic and emetic.

Administration.—Ammonium carbonate is given in ball, or in solution in cold water, to avoid irritating fumes; also, with syrup or gruel. It is often prescribed with other stimulants and antispasmodics, as alcohol, capsicum, camphor and asafœtida.

Uses.—The indications for the administration of ammonium

carbonate are much the same as those for ammonia preparations. It is a more useful expectorant, however, and it and the aromatic spirit are more serviceable in the treatment of flatulence. For the latter condition in horses with colic a ball containing ammonium carbonate ʒ ii., and capsicum ʒ i., with sufficient linseed meal and molasses to make the proper bulk and consistency, is often efficient. We may use ammonium carbonate alone in the case of acute or chronic bronchitis, or it may be combined with other stimulants, or expectorants, as ammonium chloride. In electric shock, so common an accident in the large cities from "live" wires, the administration of full doses of aromatic spirit diluted with half a pint of water will prove a most effective heart stimulant when the animal can swallow.

Ammonii Chloridum. Ammonium Chloride. NH_4 Cl. (U. S. & B. P.)

Synonym.—Sal ammoniac, ammonia muriatica or hydrochloratum, chloruretum ammonicum, sal ammonicum, ammoniæ hydrochloras or murias, muriate or ammonia, E.; chlorure d'ammonium, sel ammoniæ, muriate d'ammoniaque, Fr.; salmiak, chlorammonium, G.

Properties.—A white, crystalline powder without odor, having a cooling, saline taste, and permanent in the air. Soluble in two parts of water; in 50 parts of alcohol. Reaction neutral.

Dose.—H., ʒ ii. (8.); C., ʒ iii.-vi. (12.-24.); Sh. & Sw., gr.xv.-xl. (1-2.6.); D., gr.iii.-x. (.2-.6).

Action Internal.—When ingested, sal ammoniac is a feeble heart and respiratory stimulant, and is not comparable to the ammonia compounds or ammonium carbonate in this respect. It is eliminated in great part unchanged by the urine, but also by the other channels. In its excretion it stimulates the mucous membranes, increases their secretions generally, and is thought to improve their nutrition. Hence it has been termed an alterative. Ammonium chloride both excites the secretion of the bronchial mucous membrane and renders it less viscid in inflammatory conditions. It is mildly diaphoretic and diuretic.

Summary.—Externally, refrigerant; internally, expectorant, alterative, feebly diaphoretic and diuretic.

Uses.—Four ounces each of nitre and sal ammoniac may be dissolved in two quarts of water as a refrigerant lotion. Sal ammoniac is indicated more especially in the second stage of acute bronchitis, in chronic bronchitis, and in chronic intestinal catarrh with diarrhea. Ammonium chloride may be given to dogs with

glycerin and chloroform water as a cough mixture. If cough is excessive, codeine or morphine sulphate can be added to this prescription with advantage.

Liquor Ammonii Acetatis. Solution of Ammonium Acetate. (U. S. & B. P.)

Synonym.—Spirit of Mindererus, spiritus Mindereri, acetas ammonicus liquidus, E.; liquor ammonii acetici, P. G.; acetate d'ammoniaque liquide, esprit de Mindererus, Fr.; essigsaure ammonium-flüssigkeit, G.

An aqueous solution of ammonium acetate ($NH_4C_2H_3O_2$) containing about 7 per cent. of the salt, together with small amounts of acetic acid and carbon dioxide.

Derivation.—Ammonium carbonate is gradually added to cold, diluted acetic acid until the latter is neutralized.

Properties.—A clear, colorless liquid, free from empyreuma, of a mildly saline, acidulous taste, and an acid reaction.

Incompatibles.—Acids and alkalies.

Dose.—H. & C., ʒ ii.-iv. (60.-120.); D., ʒ ii.-viii. (8.-30.).

Action.—Spirit of Mindererus stimulates the secretory cells of the kidneys and sudoriparous glands. In the stomach it exerts a mild, antacid action.

Summary.—Externally, refrigerant; internally, diuretic, diaphoretic and antacid.

Uses.—Liquor ammonii acetatis is an exceedingly feeble medicine ("it is useful for the harm it has not done") and is often employed as a vehicle with more powerful agents of its class, *e.g.*, spiritus etheris nitrosi. It is useful as a febrifuge.

℞	Tinc. aconiti	ʒ ii.
	Sodii bromidi	ʒ iv.
	Sp'r. ætheris nitrosi	℥ ss.
M.	Liquor. ammonii acetatis ad	ʒ iv.
S.	Teas. every hour.	

The foregoing prescription is a good palliative combination for dogs suffering with fever and restlessness. The solution of ammonium acetate is frequently conjoined with sweet spirit of nitre and ammonium chloride or potassium iodide, in the treatment of acute respiratory diseases of horses, *e.g.*, influenza, bronchitis and pneumonia. It may be added to the drinking water without rendering it unpalatable.

Lithium.

(*The Metal is not Used in Medicine.*)

Lithii Carbonas. Lithium Carbonate. $Li_2 Co_3$. (U. S. & B. P.)

Synonym.—Carbonas lithicus, carbonate of lithia, E.; Lithium carbonicum, P. G.; carbonate de lithine, carbonate lithique, Fr.: kohlensaures lithion, G.

Derivation.—Made by action of lithium chloride on acid ammonium carbonate.

$2\ Li\ Cl + NH_4\ HCO_3 = Li_2CO_3 + NH_4Cl + HCl$. Purified by washing with alcohol and drying.

Properties.—A light, white powder, odorless, and having an alkaline taste. Permanent in the air. Soluble in 75 parts of water; insoluble in alcohol. Reaction alkaline.

Dose.—D., gr.iii.-x. (.2-.6).

Lithii Citras. Lithium Citrate. $Li_3C_6H_5O_7$. (U. S. & B. P.)

Synonym.—Lithium citricum, citrate of lithia, E.; citrate de lithine, Fr.; citronsaures lithion, G.

Derivation.—Made by action of citric acid on lithium carbonate.

$2\ H_3C_6H_5O_7 + 3\ Li_2CO_3 = 2\ Li_3C_6H_5O_7 + 3\ H_2O + 3\ Co_2$. Recovered by evaporation and crystallization.

Properties.—A white powder, odorless, and having a cooling, faintly alkaline taste; deliquescent on exposure to air; soluble in 2 parts of water; almost insoluble in alcohol or ether. Reaction neutral.

Dose.—D., gr.v.-xx. (.3-1.3).

Action of Lithium Salts.

Lithium salts are said to form soluble compounds with uric acid in the blood, and so assist its elimination in the urine. As lithium combines more readily with acid sodium phosphate in the blood than with uric acid, it is doubtful whether it is a very efficient

uric acid* solvent in the body. The lithium salts alkalize the urine and notably increase its secretion.

Summary.—Lithium salts are diuretics, and uric acid solvents in some degree. The carbonate may be given in powder or pill; the citrate in solution.

Uses.—Lithium compounds are of little value in veterinary medicine. They are serviceable, however, in the treatment of dogs with a very acid urine of high specific gravity; with uric acid calculus, or those affected with chronic rheumatism. The salts will not dissolve calculi in the body, but prevent their formation.

Water is extremely useful in such conditions. Lithium citrate may be placed in the drinking water. Thirst should be encouraged by the administration of salt on the food, and high rectal injections may be given to create absorption of water by this channel. Lithium salicylate is thought to be the better salt for rheumatism. It is probable that treatment with salicyclic acid and lithium would be more satisfactory.

SECTION III.

Alkaline Earth Metals: Calcium, Barium and Magnesium.

Calcium.

(The Metal Calcium is not Employed in Medicine.)

Creta Præparata. Prepared Chalk. $Ca\ Co_3$.
(U. S. & B. P.)

Synonym.—Drop chalk, E.; craie prêparée, Fr.; präparirte kreide. G.

Derivation.—Made from chalk by levigation, elutriation and dessication.

Properties.—A white, amorphous powder, often moulded into conical drops; odorless and tasteless; permanent in the air. Almost insoluble in water; insoluble in alcohol.

Incompatibles.—Sulphates and acids.

Dose.—H., ʒ i.-ii. (30.-60.); C., ʒ ii.-iv. (60.-120.); Sh. & Sw., ʒ ii.-iv. (8.-15.); D., gr.x.-ʒ i. (.6-4.).

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* Uric acid can not exist as such in blood, which is an alkaline fluid.

PREPARATIONS.

Pulvis Cretæ Compositus. Compound Chalk Powder. (U. S. P.)
Chalk, 30; acacia, 20; sugar, 50.
Dose.—D., gr.x.-ʒ i. (.6-4.).

Mistura Cretæ. Chalk Mixture. (U. S. P.)
Compound chalk powder, 20; cinnamon water, 40; water to make 100.
Dose.—D., ʒ i.-ii. (30.-60.).

Pulvis Cretæ Aromaticus (B. P.)
Dose.—D., gr. x.-ʒi. (.6-4.).

Pulvis Cretæ Aromaticus Cum Opio. (B. P.)
(Contains 2½ per cent. opium.)
Dose.—D., gr.x.-xl. (6.-2.6).

Calcii Carbonas Præcipitatus. Precipitated Calcium Carbonate. $CaCO_3$. (U. S. & B. P.)

Synonym.—Calcis carbonas præcipitata, B. P.; precipitated carbonate of lime, creta præcipitata, carbonas calcicus præcipitatus, E.; calcaria carbonica præcipitata, P. G.; carbonate de chaux prê cipité, craie prêcipitêe, Fr.; præcipitirten kohlensauren kalk, G.

Derivation.—Obtained by precipitation of calcium chloride with sodium carbonate.

$CaCl_2 + Na_2CO_3 = CaCO_3 + 2$ NaCl. Dry the precipitate.

Properties.—A fine, white powder, without odor or taste, and permanent in the air. Nearly insoluble in water; insoluble in alcohol. The solubility is increased by presence of carbon dioxide. Permanent in air.

Dose.—H., ʒ i.-ii. (30.-60.); C., ʒ ii.-iv. (60.-120.); Sh. & Sw., ʒ ii.-iv. (8.-15); D., gr.x.-ʒ i. (.6-4.).

Calcium Carbonate.

Action External.—Dessicant and slightly astringent powder; also protective.

Action Internal.—Alimentary Canal.—Calcium carbonate is the slowest acting antacid, because of its comparative insolubility, and is of value when it can exert its long-continued influence throughout the digestive tract. It resembles bismuth in mechanically coating or protecting inflamed or irritable surface. It is not so astringent nor antiseptic as the bismuth salts, and these are generally preferable to chalk for the smaller animals. It is excreted unchanged in the feces.

Administration.—Calcium Carbonate may be given to dogs in troches, pills or powder; to other animals in powder, balls or electuary. Chalk is commonly prescribed suspended in flour gruel, milk or mucilage to the larger animals. The official preparations are suitable for dogs.

Uses.—Chalk forms a dusting powder for moist eczema, slight burns and intertrigo, zinc oxide and starch (1 to 4) is, however, a better preparation. Chalk is the most useful antacid for diarrhea accompanied by fermentation of the intestinal contents, while its local astringent and protecting influence assist in overcoming the trouble. It is especially good for foals and calves given in flour gruel, and often combined with catechu, ginger and opium. The following prescription is appropriate for dogs with diarrhea:

Tinc. kino, tinc. catechu co. and tinc. opii camphor, aa ℥ ss.; mistura cretæ to make ℥ iv. S. Teaspoonful every three hours. A serviceable ball for horses with diarrhea contains: Creolin, chalk and ginger, aa ℥ ss.; powdered opium, ʒ i.

Calx. Lime. CaO. (U. S. & B. P.)

Synonym.—Burned lime, quicklime, calcaria, calx viva, calx usta, oxydum calcicum, E.; calcaria usta, P. G.; chaux, chaux vive, Fr.; kalk, gebrannter kalk, G.

Derivation.—Prepared by burning white marble, oyster shells, or the purest varieties of natural calcium carbonate, to expel carbon dioxide.

Properties.—Hard, white, or grayish-white masses, which in contact with air gradually attract moisture and carbon dioxide and fall to a white powder; odorless; of a sharp, caustic taste. Reaction intensely alkaline. Soluble in about 7.60 parts of water; insoluble in alcohol.

PREPARATIONS.

Liquor Calcis. Solution of Lime. (U. S. & B. P.)

A saturated, aqueous solution of calcium hydrate.

Synonym.—Lime water, solution of calcium hydrate, aqua calcariæ ustæ, aqua calcis, calcaria soluta, oxydum calcium, aqua solutum, E.; aqua calcariæ, P. G.; eua (liquor) de chaux, Fr.; kalkwasser, G.

Derivation.—Dissolve in lime water. The percentage of calcium hydrate [$Ca(OH)_2$] varies with the temperature, being somewhat over 0.17 per cent. at 15° C. (59° F.), and diminishing as the temperature rises.

Properties.—A clear, colorless liquid without odor, and having a saline and feebly caustic taste. It absorbs carbon dioxide from the air, so that a

pellicle of calcium carbonate forms on the surface of the liquid. Reaction strongly alkaline.

Dose.—H. & C., ʒ iv.-vi. (120.-180.); Calves, ʒ ii. (60.); D., ʒ i.-viii. (4.-30.)

Syrupus Calcis. Syrup of Lime. (U. S. P.)

Lime, 65; sugar, 350; water to make 1000.

Dose.—Calves and dogs, ʒ ss.-i. (2.-4.). Well diluted with water or milk.

Linimentum Calcis. Lime Liniment. (U. S. & B. P.)

Synonym.—Carron oil.

Solution of lime and linseed oil, of each one volume.

Dose.—Foals and calves, ʒ ii.-iv. (60.-120.).

Calcii Hydras. Slaked Lime. (B. P.)

Used as disinfectant in stables.

ACTION OF LIME AND SOLUTION OF LIME.

External.—Lime is caustic, but less so than potassium or sodium hydrate. It is an irritant. The dust of quicklime will cause conjunctivitis. If inhaled, it will cause inflammation of the air passages; if swallowed, irritation of the digestive tract. The hydrate is a caustic also, but is not so active as lime. Solution of lime is a sedative and astringent.

Internal.—Neither lime nor slaked lime (calcium hydrate) are used internally, except in the official preparations. The action of lime and its solution is due, not to calcium, but to the hydroxyl ion—that is, to the alkalinity. As compared with the alkalies the action is much slower and less in degree, on account of the comparative insolubility of calcium compounds. Solution of lime acts as a sedative, antacid and astringent in the stomach. It dissolves mucous secretions. Lime water is also a mild astringent in the bowels.

Uses.—Lime is employed outside of the body to destroy putrefying organic matter by combining with water and forming slaked lime, which absorbs many of the products of decomposition. Whitewash, a mixture of slaked lime and water, is not a disinfectant, although it covers sources of infection. It may be made so by combination with sufficient phenol to make a 2 per cent. solution. Linimentum calcis is one of the most satisfactory applications for superficial burns and acute eczema. Old clean cotton or linen cloths are soaked in it and spread over the burned surface of the body. This preparation has been facetiously called "carrion" instead of carron oil, because it is not germicidal. Antiseptic applications are of

course desirable in burns, giving rise to a raw surface, and the addition of two per cent. of carbolic acid will not only render the preparation antiseptic, but more or less anesthetic as well. When the burn is extensive, boric acid with vaseline (1 to 8) will be safer. Orthoform (see p. 234) is the most comfortable application which can be made on burns, but is expensive. A mixture of slaked lime and charcoal, equal parts, makes a useful stimulant, absorbent, dessicant, and antiseptic dressing powder for wounds and ulcers in horses. Lime water is serviceable in relieving itching in skin diseases, and dries up moist surfaces through its astringent properties. With carbolic acid (1 to 50) lime water is most efficient in allaying pruritus. Lime water is inimical to apthous ulcerations and may be employed to swab out the mouth in this disease. Enemata of lime water destroy pin worms. Solution of lime is one of the best remedies in the treatment of vomiting dogs. It is a direct sedative to the stomach, and, mixed with milk, equal volumes, prevents the rapid coagulation of the casein, lessens the formation of large, tough curds in the stomach, and assists the retention and digestion of milk. Syrup of lime is twenty-four times stronger in calcium hydrate than lime water, and is more astringent. It may be given to foals and calves suffering from indigestion and diarrhea. It should be administered in a considerable quantity of milk.

Lime water may be given as an antidote in poisoning by acids. Carron oil is a good, mild laxative and antacid for horses with "heaves." It is given on the food. Furthermore, it is an excellent purgative for foals and calves in the treatment of diarrhea and indigestion.

CALCII PHOSPHAS PRÆCIPITATUS. Precipitated Calcium Phosphate. $Ca_3(PO_4)_2$. (U. S. P.)

Synonym.—Calcis phosphas præcipitata, B. P.; precipitated phosphate of lime, phosphas calcicus præcipitatus, E.; calcaria phosphorica, P. G.; phosphate de chaux hydrate, Fr.; phosphaursaure kalkerde, G.

Derivation.—Obtained from bone ash (impure calcium phosphate) by solution in hydrochloric acid and purified by precipitation with ammonia water and by washing with water.

Properties.—A light, white, amorphous powder; odorless and tasteless and permanent in the air. Almost insoluble in cold water; insoluble in alcohol; easily soluble in hydrochloric or nitric acids.

Dose.—H., ʒ ii.-iv. (8.-15.); C., ℥ ss.-i. (15.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr.v.-xx. (.3-1.3).

Syrupus Calcii Lactophosphatis. Syrup of Calcium Lactophosphate. (U. S. & B. P.)

Precipitated calcium carbonate, 25; lactic acid, 60; phosphoric acid, 36; orange flower water, 50; sugar, 725; water, a sufficient quantity to make 1,000.

Dose.—Foals and calves, ʒ ss.-i. (15.-30.); D., ʒ i.-iv. (4.-15.).

Calcium Phosphate.

Action and Uses.—Calcium salts are most important constituents of the body, being essential for the contractibility of muscles, the activity of nerves, the coagulability of blood and, as calcium phosphate, forming 50 per cent. of bones. Calcium salts mostly pass unchanged through the bowels. A small amount is absorbed and eliminated by the large bowel and by the kidneys. The food ordinarily contains an amount of lime in excess of the needs of the body. By withholding lime from the food animals may develop conditions similar to rickets.

Rickets, however, is not usually due to lack of lime salts, but to an abnormal condition in which the lime ingested cannot be deposited in the bones, although abounding in the blood. Lime being deficient in the bones in rickets and osteomalacia, it has been given in these conditions and also in caries and fragilitas ossium. Unless the food has been deficient in calcium salts their use will probably be of little benefit.

The same comment applies to the administration of calcium salts in delayed union in fractures and in anemia, malnutrition, and weakness of young animals. In the latter conditions the calcium salt should be given with iron. Calcium phosphate should be given on food with iron to improperly nourished pregnant animals and prevents loss of the young through marasmus and rickets.

Administration.—Precipitated calcium phosphate may be given on the food, but is more readily absorbed if it is administered in the syrup of calcium lactophosphate. A glycerophosphate of lime has recently come into vogue and preparations are made containing the glycerophosphates of lime, potassium, magnesium, iron, sodium and quinine. They are used in anemia and malnutrition and convalescence.

Dose, of the glycerophosphate of calcium and iron—H., ʒ i.-ii.; D., gr.v.-x.

Calci Chloridum. Calcium Chloride. $CaCl_2$.
(U. S. & B. P.)

Derivation.—Neutralize hydrochloric acid with calcium carbonate and evaporate: $2HCl + CaCO_3 = CaCl_2 + CO_2 + H_2O$. Fusion at the lowest possible temperature renders the salt anhydrous.

Properties.—White, translucent, hard fragments; odorless; having a sharp, saline taste, and very deliquescent. Soluble in 1.3 part of water, in 8 parts of alcohol.

Dose.—H. & C., ʒ ss.-i. (15.-30.); D., gr.5-20 (.3-1.3).

Gelatinum. Purified Gelatin. (U. S. P.)

Derivation.—The purified air-dried product of the hydrolysis of certain animal tissues, as skin, ligaments, and bones, by treatment with boiling water.

Properties.—An amorphous, more or less transparent solid, usually shredded or in thin sheets; colorless or with a slight yellowish tint, inodorous, and having a slight, characteristic, almost insipid taste. Insoluble in cold water, but swells and softens when immersed in it, gradually absorbing 5 to 10 times its weight of water. Soluble in boiling water and glycerin, insoluble in alcohol, ether and chloroform, fixed and volatile oils.

Actions and Uses.—Calcium chloride has been used of late extensively both to prevent and arrest hemorrhage. Outside of the body, calcium chloride causes blood to coagulate more quickly and firmly than usual, and the same kind of action appears to obtain—*i.e.,* rendering blood more coagulable—when the salt is given internally. Calcium chloride is an efficient hemostatic in hematemesis, hemoptysis, purpura hemorrhagica and in all conditions giving rise to hemorrhage. When administered by the mouth several days before surgical operations in maximum doses it may lessen hemorrhage in cases likely to be attended by much bleeding. Two per cent. solutions of gelatin in normal salt solution have been given by the mouth, rectum and subcutaneously for the same purposes, and it is thought that the gelatin owes its power in arresting hemorrhage to the calcium (0.6 per cent.) contained in it. Unless gelatin is sterilized fractionally for half an hour on three to five successive days, tetanus may ensue when it is injected under the skin, and numerous cases have been reported following such use in human surgery. Merck sells a perfectly sterilized gelatin. The simplest manner of employing gelatin to arrest hemorrhage internally is by injection per rec

tum: 1½ ounces for small animals and 10 ounces to a pint for larger animals of the following aqueous solution, given at body temperature after the bowel has received a cleansing enema of boiled water. The solution is made of gelatin to the amount of 6 per cent. and calcium chloride to the amount of 1 per cent., to which a little laudanum may be added to prevent expulsion. It should be repeated every five hours as long as there is danger of hemorrhage. Experiments by H. C. Wood, Jr., appear to show that gelatin may be given *ad libitum* by the mouth and retain its hemostatic action; therefore gelatin should be given freely in this way as well. Aqueous solutions of gelatin 10 per cent. with calcium chloride 1 per cent., have been used locally to arrest bleeding in wounds and cavities of the body, but considering the danger of tetanus and the fact that adrenalin chloride is a better local hemostatic, such a use of gelatin is inadvisable.

Calx Chlorata. (*See Chlorine*, p. 219.)

Calcii Sulphas Exsiccatus. (U. S. P.) Dried Calcium Sulphate, or Plaster of Paris, used for bandages.

Barium.

(*Barium is not used in the metallic state.*)

Barii Chloridum. Barium Chloride. $BaCl_2$. (Non-official.)

Derivation.—Native barium sulphate is fused with charcoal. The resulting sulphide is treated with hydrochloric acid. $BaSO_4 + 2C = BaS + 2\ CO_2$. $BaS + 2\ HCl = BaCl_2 + H_2S$.

Properties.—Occurs in colorless, glistening, rhombic plates; taste bitter and disagreeable; permanent in dry air; soluble in 2.5 parts of cold water; reaction neutral.

Dose.—H., 3 i-ii by mouth; intravenously, gr. xv.

Action Internal.—Barium chloride is an intense irritant if swallowed in considerable amount and in insufficient dilution. Large medicinal doses stimulate the muscular coat of the bowels and cause increased peristalsis and purging. Evacuations from the bowels follow in horses one-half to one hour after the salt is given in drench; in one to two hours after administration to these animals in ball; in a few minutes after intravenous injection. Subcutaneous injection will occasion abscess. The drug resembles physostigmine in its action on the intestines.

Heart and Blood Vessels.—Barium chloride makes the ventricular contractions of the heart stronger and slower. The salt acts entirely on the heart muscle and does not influence the vagi. Lethal doses are followed by slower and slower ventricular contractions, succeeded by peristalsis of the cardiac muscle, and, finally, by stoppage of the heart in systole.

Barium chloride also directly excites the muscular walls of the capillaries, and, like physostigmine, increases vascular tension in small doses.

Muscles.—Barium chloride stimulates muscular contraction when it is applied locally. The potassium salts antagonize the action of barium chloride on the circulation and muscles. Toxic doses, given intravenously, cause convulsions owing to stimulation of the spinal cord and medulla. This is succeeded by paralysis of the central nervous system.

Summary.—Circulatory stimulant, and purgative in large medicinal doses.

Uses.—Many practitioners are afraid to use barium chloride, but repeated use of the drug has convinced us that it is absolutely safe when given in the dose of 1 gram or 15 grains, intravenously, or 4 to 8 grams (1 to 2 drachms) by the mouth in solution for the horse. Barium chloride is of the greatest value in colic and obstinate constipation of horses. It may for the time cause some increase of pain but not nearly as much as follows the use of eserine or arecoline, and it quickly passes off when the bowels are moved. Great care should be exercised to avoid introduction of the barium solution into the connective tissue while injecting it into the vein. The needle of the hypodermic syringe should be introduced into the jugular about midway of the neck, and after some drops of blood have exuded from the vein, the syringe is attached and slowly emptied, when the plunger is withdrawn until some blood enters the syringe. Then the needle may be removed with safety. It is rarely necessary to repeat the dose of barium chloride, and small doses of fluidextract of cannabis indica may be given to lessen colic while barium is acting, when it is given by the mouth.*

Extensive experiments of Muir† with barium chloride lead him to conclude that the salt may be administered intravenously in the amount of 1.0 to 2.0 gm. (15 to 30 gr.) in 1 to 2 drachms of sterile water; that 2 gm. is a safe dose by the intrajugular method for a horse of ordinary weight and fair condition; that the drug acts

*Lockhart reports two deaths in horses from 2½ and 3 drachms of barium chloride by the mouth and he warns that the efficient cathartic dose approaches the lethal limit with this drug. (Amer. Vet. Review, Apr., 1914).

†Jour. of Comp. Med. and Vet. Archives, Jan. and Feb., 1899.

promptly when given in this way, catharsis being produced within one to nine minutes, and that even volvulus may be relieved; that there are no unpleasant symptoms following the smaller dose (1 gm.), and that even after the 2 gm. dose there are only slight signs of pain and sweating; that while the passages from the bowels are few in number the total amount of feces is large; finally, that the drug has the advantage of being cheap.

That the toxic line is closely approached in giving barium chloride in the dose of 2 gm. intravenously, is shown by experiment 31,* in which a gelding weighing 900 pounds received two 2 gm. doses intrajugularly at about 2¾ hours apart, when death occurred from heart failure in nine minutes after the second dose. Barium chloride is also useful in relieving tympanites of cattle.

Four to five drams are given to cattle and one and one-quarter drams to calves in drench.

Magnesium.

(*The metal is not used in medicine.*)

Magnesii Sulphas. Magnesium Sulphate. $MgSO_4 + 7\ H_2O$. (U. S. & B. P.)

Synonym.—Epsom salts, sal amarum, sal Epsomense, sal anglicum, sulfas magnesicus, etc., E.; magnesia sulfuria, P.G.; sulfate de magnésie, sel d'Epsom, sel de seidlitz, sel amer, Fr.; bittersalz, schwefelsaure magnesia, G.

Derivation.—It is obtained from native dolomite, a double carbonate of magnesium and calcium, or magnesite ($MgCO_3$). $MgCO_3 + H_2SO_4 = MgSO_4 + H_2O + CO_2$.

Properties.—Small, colorless, rhombic prisms, or acicular crystals, without color, and having a cooling, saline and bitter taste; slowly efflorescent in dry air; soluble in .85 part of water; insoluble in alcohol; reaction neutral.

Incompatibles.—Lime water, alkaline carbonates, phosphoric acid, phosphates, silver nitrate and lead acetate.

Dose.—H., laxative, ℥ ii.-iv. (60.-120.); C., purgative, ℔i.-ii. (500.-1,000.); laxative, ℥ iii.-iv. (90.-120.); Calves, ℥ ii.-iii. (60.-90.); Sh., ℥ iv.-vi. (120.-180.); D., ℥ i.-iv. (4. 15.).

Action Internal.—Epsom and Glauber's salts are the best purgatives for general purposes in the treatment of cattle and sheep. The mode of action of Epsom salts is similar to that described under

* Jour. of Comp. Med. and Vet. Archives, Jan. and Feb. 1899.

sodium sulphate. Briefly, magnesium sulphate causes purgation by increasing intestinal secretion, retarding absorption of fluid from the bowels, and probably by stimulating peristalsis. The salt moves the bowels, in the case of the larger animals, usually within twelve or fifteen hours.

Epsom salt is absorbed to some extent, and is eliminated by the kidneys and sweat glands, increasing the secretions of these organs, especially when the dose is small.

Summary.—Hydragogue cathartic. Feeble diuretic and diaphoretic.

Uses.—For uses the reader is referred to Sodium Sulphate (p. 131), as they are almost identical. Epsom salt is useful in febrile diseases of horses, as in influenza and pneumonia, given in solution, in doses of two to four ounces daily. Solutions of magnesium sulphate produce local anesthesia when injected under the skin or intraspinally.

Tucker has shown that magnesium sulphate is useful in acute sprains and rheumatism, dermatitis, erysipelas, neuralgia and orchitis applied to the affected parts in saturated solution on gauze compresses wrung out in the fluid and covered by a waterproof material. Its beneficial action is partly to be ascribed to its local anesthetic influence.

The intravenous injection of magnesium sulphate causes general anesthesia and death by paralysis of the respiratory centre. It acts locally and intradurally much like cocaine as a local anesthetic. 1cc. of a 25 per cent. solution for each 25 lbs. body weight is injected intradurally to cause spinal anesthesia. Loss of sensation and motion may last for 14 hours.

Recently several deaths have been reported in humans by Boos owing to swallowing concentrated solutions of an ounce or more with absorption. He warns against using solutions containing more than 6 per cent. to avoid absorption and poisoning.

Therefore there may be some danger in using concentrated solutions of Epsom salts, which are often used to withdraw water from the blood in dropsies.

The subcutaneous injection of 20 c.c. of a saturated solution of magnesium sulphate (Squibb's) in each side of the neck of a horse, twice daily, will relieve the spasms of tetanus. Mohler and Eichorn in a severe acute case gave this treatment with complete recovery. The spasms began to relax on the fifth day and on the twelfth day the injection was given once daily for another 10 days. Antitoxin should be used also to neutralize the toxins. Ten drams of a 25 per cent. solution have been injected intraspinally with good effect in equine tetanus, but such treatment is not without danger.

Magnesii Carbonas. Magnesium Carbonate. $(MgCo_3)_4$ $Mg(OH)_2 + 5H_2O$. (U. S. P.)

Synonym.—Magnesii carbonas ponderosa, or magnesii carbonas levis, B. P.; magnesia alba, magnesia hydricocarbonica, carbonas magnesicus, carbonate of magnesia, E.; magnesia carbonica, P.G.; carbonate de magnésié, magnésie blanche, Fr.; weisse magnesia, G.

Derivation.—Mix concentrated, boiling, aqueous solutions of magnesium sulphate and sodium carbonate, and evaporate.

$5MgSO_4 + 5Na_2CO_3 + H_2O = (MgCO_3)_4Mg_4(OH)_2 + 5 NA_2SO_4 + CO_2$. Purified by digestion with water, filtration and drying.

Properties.—Slight, white, friable masses (heavy magnesium), or a bulky, white powder (light magnesium), without odor, and having a slightly earthy taste; permanent in the air; almost insoluble in water, to which, however, it imparts a slightly alkaline reaction; insoluble in alcohol.

Dose.—Foals and calves, 3 i.-ii. (4.-8.); D., gr.v.-3 i. (.3-4.).

Magnesii Oxidum. Magnesium Oxide or Magnesia. MgO. (U. S. & B. P.)

Synonym.—Magnesia levis, light magnesia, B. P.; calcined magnesia, magnesia calcinata, E.; magnesia usta, P. G.; magnésie calcinée, Fr.; gebrannte magnesia, G.

Derivation.—Heat magnesium carborate. $4 (MgCO_3) Mg (OH)_2 + 5 H_2O = 5 MgO + 6 H_2O + 4CO_2$. Water and carbon dioxide are driven off and magnesia (MgO) is left.

Properties.—A white, very bulky, very fine powder, without odor, and having an earthy, but not a saline taste. On exposure to the air it absorbs moisture and carbon dioxide; almost insoluble in water; insoluble in alcohol.

Dose.—Foals and calves, 3 i.-ii. (4.-8.); D., gr.v.-3i. (.3-4.).

Magnesii Oxidum Ponderosum. Heavy Magnesium Oxide, or Heavy Magnesia. MgO. (U. S. P.)

Derivation.—Made from light magnesia by trituration with alcohol, drying and pulverizing.

Properties.—A white, dense, very fine powder. Only differs in tests from light magnesia in that it does not readily unite with water to form a gelatinous hydroxide.

Dose.—Foals and calves, 5 i.-ii. (4.-8.); D., gr.v.-5 i. (.3-4).

ACTION OF MAGNESIUM CARBONATES AND OXIDES.

Internal.—Alimentary Canal.—These salts are antacid and counteract abnormal acidity when exhibited after a meal. The carbonate also exerts a sedative action in liberating carbon dioxide in the stomach, and both the carbonate and oxide unite with the gastric juice to form chlorides, lactates and bicarbonates. These compounds are mild, saline purgatives.

Blood and Urine.—The oxide and carbonate of magnesium alkalize the blood and urine, and are slight diuretics. They resemble potassium and sodium bicarbonates, as antacids, but are milder because feebly absorbed.

Uses.—Phillip's milk of magnesia is a good laxative and antacid preparation for puppies. One or more teaspoonfuls may be added to milk, which will be taken voluntarily. Magnesia is a useful remedy for foals and calves affected with intestinal indigestion, tympanites and acid diarrhea. It may be given to advantage in powder: magnesia and rhubarb, 2 drachms each; with ginger, one drachm. This dose should be administered in milk or flour gruel. Magnesia may give rise to intestinal concretions if its use is persisted in for a considerable period.

Magnesium carbonate and oxide are antidotes to mineral acids, oxalic acid, salts of mercury, arsenic and copper, and alkaloids, by alkalizing the gastric contents and rendering these bodies insoluble. Arsenic antidote is kept on hand at drug stores and is made by adding solution of ferric sulphate to an aqueous mixture of magnesia (see Ferri Oxidum Hydratum cum Magnesia, p. 186).

Heavy Metals: Including Aluminum, Cerium, Plumbum, Argentum, Zincum, Cuprum, Bismuthum, Ferrum, Manganum and Hydrargyrum.

Aluminum.

(*The metal is not used as medicine.*)

Alumen. Alum. Alk $(SO_4)_2 + 12\ H_2O$ (U. S. & B. P.)

Synonym.—Potassium alum, aluminum and potassium sulphate, sulphate of aluminum and potassium, E.; alun, sulphate d'alumine et de potasse, Fr.; alaun, kalialaun, G.

Derivation.—From alum slate, clay, shale, or schist, a native mixture of aluminum silicate and iron sulphide. This is roasted and exposed to the air, when the sulphur is oxidized into sulphuric acid and combines in part with aluminum and iron to form sulphates. The mass is lixiviated with water, and aluminum and iron sulphates together with sulphuric acid are recovered in solution. The solution is concentrated and to it is added potassium chloride. The double sulphate of potassium and aluminum (alum) is formed, which crystallizes out on cooling, while potassium sulphate and ferric chloride remain as bye-products. Alum is purified by recrystallization.

Properties.—Large, colorless, octohedral crystals, sometimes modified by cubes, or crystalline fragments; without odor, but having a sweetish and strongly astringent taste. On exposure to the air the crystals are liable to absorb ammonia and acquire a whitish coating. Soluble in 9 parts of water. It is also soluble in warm glycerin; insoluble in alcohol; reaction acid.

Incompatibles.—Iron, lead and mercury salts, alkalies, lime, tartrates and tannic acid.

Dose.—H. & C., 5 ii.-iv. (8.-15.); Sh. & Sw., gr.xx.-5 i (1.3-4.); D., gr.v.-x. (.3-.6); emetic, D., 5 i. (4.).

ALUMEN EXSICCATUM. Dried Alum. $AlK.(SO_4)_2$ (U. S. P.)

Synonym.—Alumen ustum, B. P.; burnt alum, E.; alum calcine (desseché brulé), Fr.; gebrannter alaum, G.

Derivation.—Heat 100 gm. of alum moderately until aqueous vapor ceases to be disengaged, and the product is reduced to 55 gm.

ALUMINI HYDROXIDUM. Aluminum Hydroxide. $Al_2(OH)_6$ (U. S. P.)

Synonym.—Aluminum hydrate, hydrated alumina, E.; alumine, Fr.; thonerdehydrat, reine thonerde, G.

Derivation.—Alum, 100 gm.; monohydrated sodium carbonate, 43 gm.; water, a sufficient quantity. Mix hot, boiling solutions of alum and sodium carbonate. Precipitate strained, washed and dried.

Properties.—A white, light, amorphous powder; odorless and tasteless; permanent in dry air; insoluble in water or alcohol.

Dose.—Same as alum.

ALUMINI SULPHAS. Aluminum Sulphate. $Al_2(SO_4)_3 + 16\ H_2O$.

Synonym.—Sulphate of aluminum, E.; sulphate d'alumine, Fr.; schwefelsäure thonerde, G.

Derivation.—Aluminum hydroxide [Al $(OH)_6$] is dissolved in diluted sulphuric acid, and the solution is filtered and evaporated to dryness.

Properties.—A white, crystalline powder, without odor, having a sweetish and afterwards astringent taste; permanent in the air; soluble in one part of water; insoluble in alcohol; reaction acid.

Dose.—Same as alum.

ALUMINUM SALTS.

Action External.—Dried alum is a superficial caustic, in contact with raw surfaces, on account of its affinity for water. It is only used externally. Alum has no action on unbroken skin, but applied to mucous membranes or denuded parts it is antiseptic and astringent; coagulates albumin of discharges; precipitates or coagulates albumin of the tissues; squeezes blood out of the vessels; reduces inflammation and makes the part whiter, tougher and denser. Alum is an hemostatic, stopping bleeding by compression of the structures surrounding the vessels, and by causing blood to clot. Alum coagulates casein and gelatine in the presence of an alkali.

Action Internal.—Stomach and Intestines.—Enormous doses of alum produce gastro-enteritis, while large doses cause vomiting in carnivora. All the secretions are diminished in the alimentary canal, and constipation ensues, unless the dose is excessive. Traces of alum are said to appear in the urine, but little is absorbed from the digestive tract and systemic poisoning is not caused by the ingestion of alum. Intravenous injection of salts of aluminum produce vomiting, weakness, tremors, convulsions, paraplegia, diarrhea, and nephritis. Aluminum induces degeneration of the brain and cord, and inflammation of the bowel and kidneys in its elimination by these parts—like the other heavy metals. Alum does not, therefore, occasion any astringent action in the body outside of the digestive tract, and is excreted by the bowels.

Uses External.—Alum is employed mainly for local surgical purposes. In arresting slight hemorrhages it may be applied in saturated solution on absorbent cotton pledgets, or in the form of burnt alum dusted upon the bleeding surface. Epistaxis may be controlled by the injection of a strong solution into the nostrils, or

by insufflation of burnt alum. Alum is sometimes used on granulating surfaces of indolent ulcers, or wounds, as a slight caustic, stimulant and antiseptic. It can be employed alone, or as a dusting powder, containing: alum, 1 part; charcoal, 4 parts; and salicylic acid, 2 parts. Alumen exsiccatum will often prevent the escape of synovia from small punctured wounds when applied to their apertures. Solutions (gr.iii.-v. to ℥ i.) are occasionally instilled into the eye in conjunctivitis, but alum is not generally so satisfactory as boric acid, zinc sulphate, or silver nitrate, in this disease. Alum crystals may be applied with profit to granular lids. Alum is used more frequently in the treatment of stomatitis, or apthous sore mouth. It is also beneficial in ptyalism. A 5 per cent. solution may be utilized to touch the inflamed oral parts by means of a swab. A spray of the same strength is serviceable for the cure of laryngitis and bronchitis in dogs.

A 2 per cent. solution is appropriate as an injection for otorrhea, or canker of the ear, attacking dogs. A similar solution will relieve leucorrhea, pruritus vulvæ, and prolapsus ani. The following combination, containing dried alum, forms an excellent preparation for application to dead tissue. It causes sloughing of the necrotic mass and is indicated when the use of the knife is inadmissible.

℞

Alumenis exsiccati	25.0
Acidi arsenosi	15.0
Acidi carbolici	10.0
Cerati	25.0

M. et fiat unguentum.

Uses Internal.—Alum is a prompt, safe and non-depressing emetic for dogs. It is suitable in poisoning, or when the secretions are excessive in laryngitis or bronchitis. Teaspoonful doses should be given in solution in syrup every 15 minutes in these latter diseases, until vomiting occurs. Alum in the proportion of 1 dram to the pint of warm water makes an excellent enema for emptying the bowels. Aluminum hydroxide is an antacid and astringent. It combines with acid in the stomach (antacid) and goes into a soluble form when it acts as an astringent in the bowels. It is, therefore, more applicable for internal use in the treatment of diarrhea and dysentery. Other astringents, such as tannic acid in some form, lead acetate, or copper sulphate, are, however, usually more valuable in diarrheal disorders. Aluminum sulphate may be used interchangeably with alum, externally or internally.

Cerium.

(*Cerium is not employed medicinally.*)

CERII OXALAS. Cerium Oxalate. $Ce_2 (C_2O_4)_3 + 9 H_2O$. (U. S. & B. P.)

Synonym.—Cerous oxalate.

Derivation.—Precipitate a solution of ammonium oxalate with a soluble salt of cerium.

Properties.—A white, granular powder, without odor or taste, and permanent in the air; insoluble in water, alcohol or ether.

Dose.—D., gr.iii.-v. (.18-.3).

Action and Uses.—The physiological details concerning the action of cerium are unknown. It is useful in relieving vomiting of a reflex or nervous character, and is often combined with bismuth salts. Cerium is absorbed with difficulty from the digestive tract. Given intravenously, it produces poisoning resembling that of bismuth.

SECTION IV.

PLUMBUM, ARGENTUM, ZINCUM, CUPRUM AND BISMUTHUM.

Plumbum.

(*Lead is not used in the metallic state in veterinary medicine, except as a last resort.*)

PLUMBI OXIDUM. Lead Oxide. PbO. (U. S. & B. P.)

Synonym.—Litharge, E.; lithargyrum, P.G.; bleiglätte, G.

Derivation.—Made by roasting lead in the air.

Properties.—A heavy, yellowish or reddish-yellow powder, or minute scales, without odor or taste. On exposure to the air it slowly absorbs moisture and carbon dioxide. Almost insoluble in water; insoluble in alcohol. Reaction faintly alkaline. Lead oxide is only valuable for its preparations.

PREPARATION.

Emplastrum Plumbi. Lead Plaster. (U. S. & B. P.)

(Diachylon Plaster.)

Lead acetate, 60; soap, 150; water, a sufficient quantity. Basis of other preparations.

Plumbi Acetas. Lead acetate. $Pb(C_2H_3O_2)_2 + 3\ H_2O$.

(U. S. & B. P.)

Synonym.—Sugar of lead, E.; sel (sucre) de saturne, Fr.; essigsaures bleioxyd, bleizucker, G.

Derivation.—Heat lead oxide in acetic acid and water.

$PbO + 2\ HC_2H_3O_2 + H_2O = Pb(C_2H_3O_2)_2 + 3\ H_2O$.

Lead acetate crystallizes on cooling.

Properties.—Colorless, shining, transparent, monoclinic prisms or plates, or heavy, white crystalline masses, or granular crystals, having a faintly acetous odor and a sweetish, astringent, afterwards metallic taste. Efflorescent and absorbing carbon dioxide on exposure to the air. Soluble in 2 parts of water and in 30 parts of alcohol. Reaction slightly acid.

Incompatibles.—Hard water, alkalies, mineral acids and salts, potassium iodide, opium, vegetable astringents and albuminous liquids.

Dose.—H. & C., 3i.(4.); Sh. & Sw., gr.xv.-xx.(1.-1.3); U., gr.i.-ii. (.06-.12).

PREPARATIONS.

Made from lead acetate in which lead exists as the subacetate, $Pb_2O(CH_3COO)_2$.

Liquor Plumbi Subacetatis. Solution of Lead Subacetate. (U. S. P.)
Liquor Plumbi Subacetatis Fortis. (B. P.)

Synonym.—Goulard's extract, acetum plumbi; cum acetum saturni, plumbum hydrico-aceticum solutum, subacetas plumbicus liquidus, E.; liquor plumbici subacetici, P. G.; sous-acetate de plomb liquide, extract de Goulard de vinaigre, plomb, Fr.; bleiessig, G.

Composition.—An aqueous liquid, containing in solution about 25 per cent. of lead subacetate (approximately), $Pb_2O(CH_3COO)_2$.

Liquor Plumbi Subacetatis Dilutus. Diluted Solution of Lead Subacetate. (U. S. & B. P.)

Synonym.—Lead Water. Lead subacetate, 40; water to make 1000.

Ceratum Plumbi Subacetatis. Cerate of Lead Subacetate. (U. S. P.)

Solution of lead subacetate, 20; camphor, 2; wool fat, 20; paraffin, 20; white petrolatum, 38.

Plumbi Carbonas. Lead Carbonate. $(PbCO_3)_2\ Pb(OH)_2$. (Non-official.)

Synonym.—White lead, E.; céruse, Fr.; bleiweiss, G.

Derivation.—Expose lead to the action of acetic acid vapor and air with carbonic dioxide.

$4\ Pb + 2\ HC_2H_3O_2 + 2\ O_2 + 2\ CO_2 = (PbCo_3)2\ Pb\ (OH)_2 + Pb(C_2H_3O_2)_2$.

Properties.—A heavy, white, opaque powder, or a pulverulent mass, without odor or taste. Permanent in air. Insoluble in water or alcohol. Used only externally.

Plumbi Nitras. Lead Nitrate. $Pb\ (NO_3)_2$. (U. S. & B. P.)

Synonym.—Salpetersaures bleioxyd, bleisalpeter, G.

Derivation.—Dissolve lead in nitric acid.

Properties.—Colorless, transparent, octohedral crystals, or white, nearly opaque crystals; without odor, and having a sweetish, astringent, and afterwards metallic taste; permanent in the air; reaction acid; soluble in 1.85 parts of water; almost insoluble in alcohol. Only used externally in 1 per cent. solution as an astringent and deodorant in gangrenous surfaces, etc.

Plumbi Iodidum. Lead Iodide. $Pb\ I_2$. (U. S. & B. P.)

Derivation.—Treat solution of lead nitrate with that of potassium iodide.

$Pb\ (NO_3)_2 + 2\ KI = PbI_2 + 2\ KNO_3$. Dry the precipitate.

Properties.—A heavy, bright, yellow powder, without odor or taste; permanent in the air; soluble in about 1,300 parts of water; very slightly soluble in alcohol; used only externally.

PREPARATION.

Unguentum Plumbi Iodidi. Ointment of Lead Iodide. (B. P.)
Employed externally to absorb glandular swellings.

ACTION OF LEAD SALTS.

External.—Soluble lead salts differ somewhat from salts of the other heavy metals in being more astringent and less irritant. This happens because they form a denser precipitate with albumin of the tissues and of secretions. The acetate which is generally used is dissociated slowly in solution in contact with the tissues. The metallic ion coagulates albumin by forming a lead albuminate, so producing a protective pellicle over raw surfaces; while the acid constituent has little effect (lack of irritation). The acetate thus makes the tissues drier, denser and harder—and contracts vessels—but has no action on the unbroken skin.

Internal.—Soluble salts of lead in concentrated solution—and at times insoluble salts—cause gastro-enteritis in large doses. Lead salts are absorbed in medicinal doses whether taken in a soluble or insoluble state. The chemical form of the lead compound at the time of absorption is unknown. Lead is deposited in the tissues, especially in the liver and kidney, and is very slowly eliminated in the urine and intestinal mucus, bile, milk and saliva. Lead salts have a marked astringent action on the entire digestive canal and diminish secretions accordingly. After absorption lead salts have no remote astringent action.

Toxicology.—Poisoning not infrequently occurs in animals at pasture, from eating paint, sheet lead, or products of lead or smelting works. The drinking water may be contaminated with lead, especially from new pipes, or lead receptacles in which water has been standing. Hard water is not affected by lead pipes, since an insoluble crust of lead phosphate and sulphate is deposited upon the interior of the pipes. There is an acute and chronic form of poisoning. The first is caused by single large doses of soluble lead salts, and is characterized by gastro-enteritis and colic; rarely there are symptoms of absorption, as convulsions, coma, paralysis and death. The feces are sometimes colored black with lead sulphide; the vomitus is white from lead chloride. Three groups of symptoms may be briefly tabulated, which occur to a greater or less degree in chronic lead poisoning:

DIGESTIVE SYMPTOMS.

Lead line on gums.
Colic.
Constipation.
Anorexia.
Thirst.
Abdomen retracted, or "tucked up."

NERVOUS SYMPTOMS.

Paralysis of tendons—extensors—of extremities.
Animals stand on knees before.
Animals stand on toes behind.
Convulsions.
General paralysis.
Wasting of muscles.
Anesthesia.
Arthralgia.
Dizziness.
Tremors.
Delirium.
Coma.
Amblyopia.

The nervous symptoms are due to peripheral neuritis and to influence on the brain and cord.

GENERAL SYMPTOMS.

Dyspnea.
Pulse accelerated.
Emaciation.
Anemia.
Edema.
General debility.
Interstitial nephritis.

Animals die in chronic poisoning from paralysis of the respiratory muscles, or in convulsions. The lead line (gray or black dotted appearance) on the margin of the gums, at their junction with the teeth on the lower jaw, is due to sulphuretted hydrogen in the mouth, acting upon the lead deposited in the gums, and forming lead sulphide. The treatment consists in removing the cause, relieving the symptoms and in hastening elimination. Potassium iodide eliminates lead in a soluble form into the bowels and kidneys. Magnesium sulphate converts lead into an insoluble sulphate in the intestines and then sweeps out the salt. The stomach pump or emetics should be employed in acute poisoning. Alum is the best emetic. This treatment should be followed by the administration of opium and Epsom salts.

Administration.—Lead acetate is given to the larger animals in solution or ball; to the smaller patients in pill; to young animals in solution in milk.

Uses External.—Lead acetate is useful in the treatment of skin diseases, as weeping eczema and erythema, and in excoriations,

blistered surfaces, bruises, strains, and burns. An efficient lotion having an astringent and sedative action in such conditions, contains: laudanum, 1 part; Goulard's extract, 4 parts; and oil, glycerin or water, 16 parts. The "white lotion" of veterinary medicine is made by adding 3 drachms each of lead acetate and zinc sulphate to a pint of water. It is a favorite astringent, sedative and antiseptic application for strains, bruises, scratches, bursitis and tenosynovitis in horses. Compresses soaked in it are bandaged to the part. Also it is of value as an injection in urethritis, and externally in balanitis of dogs. The stronger solution of lead subacetate should not be employed extensively on raw surfaces or mucous membranes undiluted. The diluted solution of lead subacetate may be used as an injection for leucorrhea. Lead acetate should be diluted with 20 to 40 parts of vinegar or water. Lead acetate is not suitable for collyria, if there is any ulceration of the cornea, because a permanent film may be deposited and obscure the sight. Lead iodide, in 10 to 20 per cent. ointment with petrolatum, has proven of service in aiding resolution of induration or caked condition of the udder in acute mammitis, if applied twice daily with thorough massage, before suppuration has set in.

Uses Internal.—Lead acetate is serviceable in the treatment of diarrhea, dysentery, and hemorrhage from the stomach and bowels. It is frequently prescribed in these diseases with opium, but should not be used over a long period.

Argentum.

Argenti Nitras. Silver Nitrate. $AgNo_3$. (U. S. & B. P.)

Derivation.—Dissolve silver in nitric acid with heat.

$3\ Ag_2 + 6\ HNO_3 = 6\ AgNO_3 + 3\ H_2$. Evaporate and crystallize

Properties.—Colorless, transparent, tabular, rhombic crystals, becoming gray, or grayish-black on exposure to light in the presence of organic matter; without odor, but having a bitter, caustic and strongly metallic taste; reaction neutral; soluble in 0.54 part of water and 24 parts of alcohol.

Incompatibles.—Alkalies and their carbonates, acids except (nitric and acetic), chlorides, potassium iodide, astringent infusions and solutions of arsenic.

Dose.—H. & C., gr.v.-x. (.3-.6); Sh. & Sw., gr.i.-ii. (.06-.12); D., gr. $\frac{1}{8}$-$\frac{1}{2}$ (.008-.03).

ARGENTI NITRAS MITIGATUS. Mitigated Silver Nitrate. (U. S. P.)

Synonym.—Argenti et potassi nitras, B. P.; mitigated caustic, E.; argentum nitricum crystallizatum, P. G.; azotas (nitras) argenticus, azotate d'argent, nitre lunaire, Fr.; salpetersaures silveroxyd, silbersalpeter, G.

Derivation.—Melt silver nitrate, 30, with potassium nitrate, 60, in a crucible at as low a temperature as possible. Mix and cast into suitable moulds.

Properties.—A white, hard solid, generally in the form of pencils or cones of a finely granular fracture; becoming gray or grayish-black on exposure to light in presence of organic matter; odorless, having a caustic, metallic taste, and neutral reaction. Each of its constituents soluble in water and alcohol to the extent mentioned under Argenti Nitras and Potassii Nitras. Used only externally.

ARGENTI NITRAS FUSUS. Moulded Silver Nitrate. (U. S. P.)

Synonym.—Lunar caustic, lapis infernalis, azotas (nitras) argenticus fusus E.; argentum nitricum fusum, P. G.; azotate d'argent fondu pierre infernale, F.; höllenstein, geschmolzenes salpetersaures silberoxyd, G.

Derivation.—Melt silver nitrate, 100, with hydrochloric acid, 4, at as low a temperature as possible. Mix and pour into suitable moulds.

Properties.—Practically same as above. Used only externally. Silver oxide, cyanide, and iodide are official, but unimportant in veterinary medicine.

ACTION OF SILVER NITRATE.

External.—Silver nitrate is more caustic in action than any of the lead, copper or zinc salts (except zinc chloride). When applied externally in the pure state to a mucous membrane, or a raw surface, it forms a white coating of coagulated protein, or silver albuminate. This coating limits the further action of the salt, so that lunar caustic is always superficial and localized in its effect. Silver nitrate is the caustic in most common use, since it produces a more healthy condition in a granulating wound after its application and separation of the eschar. Silver compounds are powerfully antiseptic because silver itself is actively antiseptic and because the nitrate destroys germs in coagulating their proteid protoplasm. In

dilution, silver nitrate is stimulant, astringent, antiseptic and caustic, according to its strength.

Internal.—Silver nitrate is probably precipitated to a considerable extent by the hydrochloric acid of the gastric juice, as the chloride. Some of it is possibly converted into the albuminate, and absorbed as such. When ingested for a long period silver is deposited in the tissues in the form of the oxide, causing dark staining of the skin in man. These stains, occurring when silver nitrate comes in direct contact with the skin, can be removed by a solution containing potassium cyanide, 2½ drachms; iodine, 15 grains; and water, 3 ounces. Large doses of silver nitrate cause gastro-enteritis with nervous symptoms—paralysis and convulsions—and death from depression of the respiratory centres. Common salt is the antidote, both externally and internally, forming the insoluble chloride. In addition to salt, opium and demulcents should be exhibited in acute poisoning. Silver nitrate in medicinal doses has probably a local stimulating, astringent and alterative action on the mucous membrane of the stomach; to a less degree on the bowels. Elimination may not take place at all—inert organic compounds being deposited in various parts of the body—or may occur slightly from the epithelium of the digestive tract. A chronic form of poisoning by silver nitrate (argyrism) is seen in man, following its continued use, and is accompanied by pigmentation of the skin, marasmus, chronic indigestion, with wasting of the testes and mammary glands. A similar condition has been produced in animals, associated with anorexia, weakness, anemia and emaciation.

Uses External. An aqueous solution (gr.iii. to ℥ i.) is most valuable in treatment of catarrhal conjunctivitis, while a stronger preparation (gr.x. to ℥ i.) is employed for purulent conjunctivitis, as a stimulant, astringent and antiseptic collyrium. When strong solutions, like the latter, are used, the eye should immediately be flooded with a solution of common salt and water to precipitate the excess of silver nitrate as the insoluble chloride and thus prevent further irritation. Lunar caustic is applied in pencil form to ulcerated surfaces. When these surfaces are touched lightly the caustic stimulates sluggish granulations; when more heavily, it destroys exuberant granulations. In 2 to 4 per cent. solution, silver nitrate is caustic to mucous membranes; in ½ per cent. solution it is stimulant and astringent to mucous membranes.

Boils may be aborted by painting them with a saturated solution of silver nitrate. Pruritus ani, or vulvæ, is relieved by painting the parts several times daily with a 4 per cent. solution. A solution (gr.iii. to ℥ i.) may be used in the form of spray in the treatment of pharyngitis and laryngitis in the dog. In catarrh of

the external ear, so common in dogs, the canal should be swabbed with a 5 per cent. watery solution of silver nitrate after thorough cleansing with ether, or alcohol and naphtha, to remove dirt and sebaceous matter. In 2 to 6 per cent. solutions silver nitrate is curative in moist patches of eczema in dogs.

Fissures in the skin occurring in sore teats of cows are cured by the application of fused silver nitrate.

Uses Internal.—The crystals should only be employed internally, to insure purity. Silver nitrate is not of much value for internal use except in the digestive tract. Pills containing the silver salt are sometimes given to dogs with diarrhea and ulcer of the stomach. Dysentery may be treated by enemata containing 12 grains of silver nitrate to the ounce of water. If this treatment is followed by much irritation, injections of salt and water should be used afterwards.

Protargol. (*Non-official.*)

Protargol was first introduced into medicine by Prof. Neisser, in 1897, as a local remedy for gonorrhea in man. It is a fine, yellowish-brown, soluble powder, a combination of a protein substance with silver; odorless, and possessing a strong metallic taste.

Protargol has recently superseded silver nitrate (which contains 64 per cent. of silver) to a considerable extent in medicine because, containing less silver (8.3 per cent.), protargol is decidedly less irritating, is not precipitated by albumin or solutions of sodium chloride, does not discolor the skin and more than equals silver nitrate in certainty and efficiency of action.

Protargol is particularly applicable in veterinary medicine as a bland but powerfully penetrating antiseptic and mild astringent in the treatment of inflammatory conditions of the conjunctival membranes. The drug does not cause the pain, redness, swelling and lachrymation which follow the use of silver nitrate; nor does it lead to the formation of fibrinous coagula and the production of false membranes and opacities of the cornea seen after the application of silver nitrate.

A 10-per-cent. solution of protargol induces less flushing of the eye and discomfort than a 1-per-cent solution of silver nitrate, and the irritation of a 2 or 4 per cent. solution is not, as a rule, more than would be produced by one-half grain to the ounce solution of zinc sulphate (Cheney).

Protargol is indicated in acute catarrhal and purulent conjunctivitis in from one-half to 10 per cent. aqueous solutions;

usually in one-half per cent. solution in the catarrhal form, two or three times daily, applied with a camel's hair brush or by instillation; and in the purulent variety, in 2 or 4 per cent. solution with a pledget of absorbent cotton on a probe, or with a camel's hair brush, in conjunction with frequent boric acid irrigations. This new silver combination has also been used with reported success (and the use might apply to canine practice) in human medicine as a non-irritating astringent and antiseptic agent internally in .5 gm. doses, twice or thrice daily, in pills, for the relief of hemorrhages and ulcerations of the alimentary canal, in diarrhea and in purulent inflammation of the genito-urinary tract. Kingston reports favorable results in purpura hemorrhagica in horses from the intravenous injection of one ounce of a 5 per cent. solution of protargol twice daily.

Argyrol.

Argyrol represents one of the latest of the numerous organic silver compounds, this preparation containing as much as 20 to 25 per cent. of the metal combined with a proteid substance obtained from wheat. It occurs as a brownish powder, soluble in less than its own weight of water, forming dark-brown solutions which stain clothing black, but the stains may be removed by solutions of corrosive sublimate. Like protargol, it is not precipitated by the salts of the tissues, nor does it coagulate albumin, so that its action is not neutralized by the tissues—as is the case with silver nitrate; and thus, unlike the latter, it possesses a penetrating power when applied locally. Argyrol is used in from 5 to 50 per cent. aqueous solution for the same purposes to which protargol is adapted. Solutions of argyrol should be freshly made. Argyrol is the most valuable silver substitute we have and so far from being irritating is actually sedative in 10 per cent. solution. In inflammatory diseases of the mucous membranes of the eye, urethra and bladder it has no equal.

Soluble Silver.

Soluble silver, known also as *Colloidal Silver*, or more commonly as *Collargol*, is an allotropic form of metallic silver (87 per cent. silver) wholly soluble in water, and discovered by Lea about 1890. It may be used intravenously, subcutaneously, by inunction (as Credé's ointment, see below), and by the mouth, if first dissolved in the proportion of five parts of collargol with one part of white of egg in one hundred parts of water; or it may be given in pill with

sugar of milk.* When given intravenously—which is the most effective mode of administration—one injection may suffice, but if it does not cause immediate improvement in the symptoms, several doses may thus be given at six-hour intervals. Soluble silver has recently proven successful in many cases of general infection, where it appears to either kill or inhibit the growth of staphylococci and streptococci. It is certainly worthy of trial in veterinary medicine in this field, where it has accomplished noteworthy results.†

Puerperal septicemia, mastitis, extensive cellulitis, fetid bronchitis, pneumonia, influenza, endo and pericarditis, deep suppurations, phlebitis, suppurating nasal sinusitis, empyema and other bacterial infections have yielded to the systemic and local influence of soluble silver in human medicine. Its expense is the only objection to its free employment in animal practice, and this applies to all the new organic silver compounds. A rigor often occurs from one to four hours after the injection of collargol, but no other ill effects have been noted. When the silver can be used locally (in local infections) it is also effective and may or may not be at the same time given intravenously, its desirability by the latter mode depending on the degree of general infection. The dose intravenously is 3½-1 (2.-4.) for horses; dogs, gr. 1-2 (.06-0.12), given in 2 to 5 per cent. aqueous solution. It is injected into the tissues as in abscess, in 1 per cent. solutions. It is soluble in 20 parts of water, which should be distilled or boiled, and solutions in water may be kept for months in brown bottles. Solutions, from having a clear, brown color, become gray and turbid when decomposed. 1-3000 aqueous solutions are appropriate for use on mucous membranes or cavities of the body.

Credé's Ointment, made by incorporating collargol with lard and wax to the extent of 15 per cent., has given good results when rubbed for thirty minutes into the skin (which has previously been scrubbed with soap, water and alcohol) in the treatment of local and even general infections. It often arrests the formation of boils, threatened suppuration of glands, lymphangitis, phlebitis, cellulitis and mastitis. The dose by inunction is ½ to 1 ounce for horses, ½ to 1 drachm for dogs. Collargol appears to be non-toxic when given intravenously or by inunction, if used with reasonable care.

* Collargol has been also given with benefit by the rectum (H., 3 i.-ii., in Oi. water; D., gr. ii.-iv. in ʒ ii.-iii. water).

† Since writing the above collargol has been gaining headway in veterinary practice. Dieckerhoff recommends it as a daily intravenous injection of 25 cc. of a 2 per cent. solution in purpura in the horse, and Wyman of Ohio speaks very favorably of its action in catarrhal diseases of the upper air passages and in septic cellulitis and lymphangitis in the horse. Collargol has also been used with reported success in strangles and septic omphalo-phlebitis in foals and calves.

Zincum.

(*Zinc is not used in Medicine in the metallic state.*)

ZINCI CHLORIDUM. Zinc Chloride. $ZnCl_2$. (U. S. & B. P.)

Derivation.—Dissolve zinc in hydrochloric acid by boiling. The solution contains the zinc chloride with chlorides of iron and lead as impurities. These are precipitated by adding first nitric acid then zinc carbonate. Filter and finally evaporate. $Zn_2 + 4\ HCl = 2\ Zn\ Cl_2 + 2H_2$.

Properties.—A white, granular powder, or porcelain-like masses, irregular or moulded into pencils; odorless; of such intensely caustic properties as to make tasting dangerous unless the salt be dissolved in much water, when it has an astringent, metallic taste; very deliquescent; reaction acid; soluble in about 0.4 part of water; very soluble in alcohol.

LIQUOR ZINCI CHLORIDI. Solution of Zinc Chloride. (U. S. & B. P.)

Derivation.—Made as above with the addition of water. It contains about 50 per cent., by weight, of zinc chloride.

Properties.—A clear, colorless liquid, odorless, having a very astringent, metallic taste and an acid reaction. Spec. gr. about 1,548 at 25° C. (77° F.).

Toxicology.—Zinc chloride is a powerful irritant if swallowed in any degree of concentration, and will, therefore, produce gastro-enteritis. Emetics or the stomach tube should be used, followed by demulcents and sodium bicarbonate.

Uses.—Zinc chloride is employed in a paste made into small pieces with flour: or on lint soaked in a saturated solution, dried, and introduced under the skin about the base of tumors to cause their destruction by sloughing. It is employed in the form of pencils on unhealthy, granulating surfaces, as in "foot rot," and injected in strong solution into fistulous tracts to destroy their walls. It is not used internally.

ZINCI SULPHAS. Zinc Sulphate. $ZnSo_4 + 7\ H_2O$. (U. S. & B. P.)

Derivation.—Prepared by dissolving zinc in sulphuric acid. $Zn_2 + 2\ H_2SO_4 = 2\ ZnSO_4 + 2\ H_2$.

Iron and tin exist as impurities, and are removed by chlorine solution and zinc carbonate.

Properties.—Colorless, transparent, rhombic crystals, without odor, and having an astringent, metallic taste. Efflorescent in dry air; reaction acid; soluble in 0.53 part of water, in 3 parts of glycerin; insoluble in alcohol.

Incompatibles.—Lead acetate, silver nitrate, lime water, alkalies and carbonates, vegetable decoctions or infusions, and milk.

Dose.—H. & C., 3 i.-ii. (4.-8.); Sh. & Sw., gr.x.-xx. (.6-1.3); D., gr.ii.-iii. (.12-.2); Emetic—D., gr.x.-xv. (.6-1.).

Zinci Carbonas Præcipitatus. Precipitated Zinc Carbonate. (U. S. P.)

Synonym.—Zinci carbonas, B. P.; precipitated zinc carbonate, kohlensaures zinkoxyd, G.

Derivation.—Solutions of nearly equal weight of sodium carbonate and zinc sulphate are boiled together; dry precipitate. $8\ ZnSO_4 + 8\ Na_2CO_3 + 2\ H_2O = 2\ (ZnCO_3)_3\ Zn\ (OH)_2$? (hydrated basic zinc carbonate) $+ 8\ Na_2SO_4 + 2\ CO_2$. This salt is in reality a mixture of zinc carbonate and oxide, in varying proportions, with water of crystallization.

Properties.—An impalpable white powder, of somewhat variable chemical composition, without odor or taste; insoluble in water or alcohol.

Zinci Oxidum. Zinc Oxide. Zn O. (U. S. & B. P.)

Derivation.—Heat the carbonate to redness.

$2\ (Zn\ CO_3)_3\ Zn(OH)_2 = 8\ ZnO + 2\ H_2O + 6\ CO_2$.

Properties.—An amorphous, white powder, without odor or taste. It gradually absorbs carbon dioxide from the air. Insoluble in water or alcohol.

Dose.—H. & C., 3 i.-ii. (4.-8.); D., gr.v.-x. (.3.6).

PREPARATION.

Unguentum Zinci Oxidi. Ointment of Zinc Oxide. (U. S. P.)
Zinc oxide, 200: benzoinated lard, 800. (U. S. P.)
Unguentum Zinci. 15 per cent. of zinc ointment. (B. P.)

ZINCI ACETAS. Zinc Acetate. $Zn(C_2H_3O_2)_2 + 2\ H_2O$.
(U. S. & B. P.)

Derivation.—Dissolve zinc oxide in diluted acetic acid and boil.

$ZnO + 2\ HC_2H_3O_2 = Zn(C_2H_3O_2)_2 + H_2O$. Evaporate and crystallize.

Properties.—Soft, white, six-sided monoclinic plates, of a pearly lustre, having a faintly acetous odor, and an astringent metallic taste. Exposed to the air the salt gradually effloresces and loses some of its acid; reaction acid; soluble in 2.5 parts of water and in 36 parts of alcohol.

Incompatibles.—Same as sulphate.

Dose.—Same as sulphate.

ACTION OF THE ZINC SALTS.

External.—The salts of zinc (except the chloride) have an astringent action on raw surfaces and mucous membranes in precipitating solutions of proteids, as zinc albuminate, notably the sulphate and acetate. Absorption is not followed by poisoning, as most of the zinc is stored in the liver. They resemble other astringents, especially copper salts, and are more irritating than lead acetate or subacetate.

Internal.—In the alimentary tract very large doses of the sulphate or acetate may induce gastro-enteritis, which is to be treated with demulcents and alkaline carbonates in order to form insoluble compounds. Vomiting will relieve carnivora; otherwise the stomach tube must be resorted to.

Zinc salts apparently produce no remote effects upon the body when ingested. Given intravenously (double salts) to mammals, zinc causes vomiting, diarrhea, muscular weakness and paralysis. It is eliminated chiefly by the alimentary tract and slightly in the bile and urine. In therapeutic doses the zinc salts are astringent, diminishing secretion in the digestive tract.

USES OF ZINC SALTS.

External.—Zinc sulphate is in common use as an astringent collyrium for subacute conjunctivitis (gr.ss.-ii. to ℥ i.). It is also employed in the treatment of canker of the ear in dogs (gr.x to ℥ i.), or as "white lotion" (see Plumbi Acetas), in this affection.

In diseases of the feet, as in canker of the horse, equal parts of zinc, copper and iron sulphates with 5 per cent. carbolic acid and vaseline q. s. to make a paste, are of value.

The salt is likewise serviceable as a stimulant and astringent solution (gr.ii.-v. to ʒ i.) in moist eczema, ulcers, atonic inflammations of mucous membranes, balanitis and urethritis in dogs, and leucorrhea.

Zinc carbonate is a much milder astringent than zinc sulphate or acetate. The impure carbonate (calamine) is an ingredient of the popular astringent and antiseptic "pink ointment" of veterinary medicine used for the cure of "scratches" in horses.

℞

Zinci carbonatis (impure)	ʒ ii.
Alumenis	ʒ iss.
Calcii carb. præcip.	ʒ x.
Creosoti	
Ceræ flavi	āā ʒ iss.
Adipis	ʒ xv.

M.

S. External use.

The lard and wax are first melted together and then the other ingredients are stirred in. Calamine in the form of a lotion is a more cleanly application for house dogs and pets than ointment or paste. The following is useful in dermatitis, erythema and moist eczema attended with itching. The carbolic acid may be omitted when the lotion is applied over a large surface to avoid poisoning by absorption or from the acid being licked off by the patient.

℞

Acidi carbolici	1.0	gr.xv.
Zinci oxidi	15.0	ʒ ss.
Calaminæ	5.3	gr. 80
Glycerini	30.0	ʒ i.
Liquoris calcis ad	240.0	ʒ viii.

M. et fiat lotio (shake).

Sig. External use.

Zinc is used externally in the form of a dusting powder, ointment or paste. In eczema, erythema and scratches, the zinc oxide ointment is valuable and can be combined with carbolic acid (gr.x to ʒ i.) or creolin (5 per cent.) to great advantage, when itching is a prominent symptom. Still better than zinc ointment is a paste containing zinc oxide, 2 parts; starch and vaseline, each 3 parts. Zinc acetate can be used in all cases as a substitute for zinc sulphate.

Internal.—Zinc sulphate is the best and most prompt emetic for dogs in many conditions, as poisoning. It should be given in tepid water. Zinc oxide is occasionally prescribed in diarrhea, and empirically as a tonic and antispasmodic in chorea and epilepsy. Zinc oxide may be given in powder, pill, or dissolved in alkaline solutions.

Zinc Valerate. See p. 484.

Zinc Phosphide. See p. 219.

Cuprum.

(*Copper is not used in the metallic state in Medicine.*)

Cupri Sulphas. Copper Sulphate. $Cu\ So_4 + 5\ H_2O$.
(U. S. & B. P.)

Synonym.—Cupric sulphate, blue vitriol, blue stone, sulfas cupricus, suprum vitriolatum, E.; cuprum sulfuricum purum, P. G.; vitriol bleu, sulfate de Cuivre, Fr.; kupfervitriol, blauer-vitriol, schwefelsaures kupfer (kupferoxyd), G.

Derivation.—Boil metallic copper and sulphuric acid together. $2\ Cu + 2\ H_2\ SO_4 = 2\ CuSO_4 + 2\ H_2$. Dissolve product in hot water and crystallize.

Properties.—Large, transparent, deep blue, triclinic crystals; odorless, of a nauseous, metallic taste; slowly efflorescent in dry air; soluble in 2.2 parts of water; almost insoluble in alcohol; reaction acid.

Incompatibles.—Mineral salts (except sulphates), alkalies and their carbonates, iodides, lime water and vegetable astringents.

Dose.—H. & C., 3i.-ii. (4.-8.); Sh. & Sw., gr.xx.-xl. (1.3-2.6); D., gr.i.-ii. (.06-.12); Emetic—D., gr.vi.-xx. (.36-1.3).

ACTION OF COPPER SULPHATE.

External.—Copper sulphate precipitates protein in solution and is stimulant, astringent or caustic to mucous membranes or raw surfaces, according to the strength applied.

Internal.—In poisonous doses copper sulphate causes salivation, vomiting, gastro-enteritis, and nervous symptoms (convulsions,

paralysis and delirium), and finally death from collapse. When injected intravenously copper salts lead to destruction of the blood, and fatty degeneration of the liver, kidneys and heart. Rarely does absorption from the digestive tract cause poisoning, since the salt is either vomited, or absorbed too slowly, or stored in the liver. The treatment consists in emptying the stomach in animals which cannot, or do not, vomit, and the use of magnesia, tannin or yellow prussiate of potash, as antidotes; and demulcents, as milk and white of egg, together with opium. Large doses are emetic to the dog, but should not be used except in phosphorus poisoning. Smaller doses are astringent in the digestive tract. The copper absorbed from the alimentary tract lodges in the liver, kidneys, and thyroid gland. It is eliminated slowly in the urine, bile, intestinal secretions, saliva and milk. Copper is a normal constituent of the tissues and has a strong affinity for hemoglobin attaching itself, on absorption, to the corpuscles as cuprohemol.

Uses External.—Copper sulphate is employed in the solid, crystalline form in granular conjunctivitis, by rubbing the stick over the affected surfaces of the lids.

A solution (gr.-ii. to ʒ i.) is dropped into the eye for simple conjunctivitis. Copper sulphate is similar in action to zinc sulphate, but more powerful. On ulcerated and granular surfaces it is used as a stimulant and astringent, as in the following mixture, a combination of cupric sulphate and zinc sulphate, of each 2½ drachms (10gm.), with solution of lead subacetate, 5 drachms (20gm.), which is of value in thrush and canker of the feet in horses, and as an application for chronic sores and unhealthy indolent granulating surfaces. It may also be applied locally with an equal part of dried alum in the form of powder for the treatment of thrush. The disappearance of the moisture and foul odor will soon herald recovery. In foot root of sheep one part each of copper sulphate and lard, with two of tar, may be prepared by melting and then mixing the ingredients.

Two ounces each of zinc and copper sulphate in one pint of vinegar are curative when injected into sinuses.

Uses Internal.—Copper sulphate is prescribed for its local effect with opium in diarrhea, and injected into the bowel in 2 per cent. solution in ulcerated conditions of the rectum. The sulphate of copper in small doses is believed to be a tonic remedy in anemia and nervous conditions, although without sufficient experimental proof. It is thought to resemble arsenic and to increase the number of corpuscles, firmness of flesh and amount of fat. Copper sulphate is often used as a vermicide in the treatment of lumbricoid worms and ozena, combined with iron. Copper sulphate in 1 drachm doses (4.0 gm.), with powdered charcoal and fenugreek, of each 1-1½

drachms (6. gm.), given to the horse night and morning for eight to ten days and followed by a brisk cathartic of aloes and linseed oil, will cause the expulsion of ascarides. It is recommended in purpura, and is given to dogs in the form of arsenite of copper for chorea and epilepsy. Copper sulphate, added to reservoirs of drinking water in the proportion of 1 part to 5 to 50 millions of water, destroys algae but is innocuous to animals. Copper sulphate forms an inert compound with phosphorus. Hydrogen dioxide or potassium permanganate are safer and more effective antidotes in phosphorus poisoning, as too large doses of copper sulphate are required for this purpose.

Cupri Acetas. Copper Acetate. (Non-official.)

Synonyms.—Verdigris, cupric subacetate, E.; acetate de cuivre, vert-de-gris, F.; grunspau, G.

Derivation.—Exposure of copper plates to pomace or residue resulting from expression of juice from grapes in wine making, or to immersion in pyroligneous acid.

Properties.—Pale-green masses of minute, acicular crystals, sometimes of bright blue hue. Verdigris is the impure article; the pure salt is known as Crystals of Venus. The taste is coppery and odor vinegar-like. Soluble in water.

Dose.—H. & C., gr.15-30 (1.-2.); Sh. & Sw., gr.5-10 (.3-.6).

Action External.—It is astringent, stimulant and escharotic according to the strength whether applied to the unbroken skin or to mucous membranes or raw surfaces.

Action Internal.—This salt is an efficient vermifuge for the expulsion of ascarides from the horse. It should be given in doses of gr.15-30 (1.-2. gm.) twice daily with powdered gentian and charcoal, 1 drachm of each (4.0 gm.), for a week and then be followed by a cathartic dose of aloes. It is a poison in large doses, causing gastro-enteritis, convulsions and death. The antidotes are milk, raw eggs and soap.

Bismuthum.

(*Bismuth is not employed medicinally in the metallic state.*)

Bismuthi Subcarbonas. Bismuth Subcarbonate. $(BiO)_2CO_3 + H_2O$? (U. S. P.)

Synonym.—Bismuthi carbonas, B. P.

Derivation.—Made by dissolving pure metallic bismuth in

diluted nitric acid, precipitating with ammonia water, and redissolving in nitric acid. This solution is treated with ammonium carbonate, or a solution of sodium carbonate.

$2Bi\ (NO_3)_3 + 3\ Na_2CO_3 + H_2O = (BiO)_2\ CO_3 + H_2O + 2\ CO_2 + 6\ NaNO_3$. The precipitated bismuth subcarbonate is filtered and washed.

Properties.—A white, or pale yellowish-white powder, of somewhat varying chemical composition; odorless and tasteless, and permanent in the air. Insoluble in water or alcohol, but completely soluble in nitric or hydrochloric acid, with copious efflorescence.

Dose.—H., 3 ii.-iv. (8.-15.); D., gr.x.xxx. (.6-2.).

Bismuthi Subnitras. Bismuth Subnitrate. $BiO\ NO_3 + H_2O$? (U. S. & B. P.)

Synonym.—Bismuthum subnitricum, P.G.; bismuthum hydriconitricum, magisterium bismuthi, subazotas (s. subnitras) bismuthicus, sous-azotate de bismuth, Fr.; basisches salpetersaures bismuthoxyd, G.

Derivation.—Dissolve pure metallic bismuth in diluted nitric acid. First reaction—$Bi_2 + 6\ HNO_3 = 2\ Bi\ (NO_3)_3 + 3\ H_2$. Final reaction—$Bi\ (NO_3)_3 + H_2O = BiONO_3 + 2\ HNO_3$. Evaporate; add water; wash and dry precipitated bismuth subnitrate.

Properties.—A heavy, white powder of somewhat varying chemical composition; odorless and almost tasteless, and permanent in the air. Almost insoluble in water and insoluble in alcohol, but readily soluble in nitric or hydrochloric acid.

Dose.—Same as subcarbonate.

Bismuthi Subsalicylas. Bismuth Subsalicylate. (U. S. P.)

Dose.—D., gr.iv (0.24).

Bismuthi Subgallas. Bismuth Subgallate. (U. S. P.)

Synonym.—Dermatol.

Properties.—A fine, amorphous, yellow powder; permanent in the air and odorless; insoluble in water, ether, alcohol or chloroform; soluble in acids; used externally as a substitute for iodoform; it is antiseptic and astringent; occasionally given internally.

Dose.—D., gr. v.-x. (.3-.6).

ACTION OF BISMUTH SUBNITRATE AND SUBCARBONATE.

External.—The insoluble salts of bismuth have a protecting, sedative, astringent and antiseptic action on raw surfaces. If applied over very extensive areas for a considerable length of time, they may cause absorption and poisoning. Bismuth has no action on the unbroken skin.

Internal.—The salts of bismuth are absorbed and eliminated to some extent. When administered continuously in enormous doses, or when absorbed from the skin or given intravenously, bismuth has caused stomatitis, vomiting, diarrhea, weakness, convulsions, blackness of the mucous membranes of the digestive tract, and death. Probably, as ordinarily used, all the bismuth absorbed from the alimentary canal is stored in the liver. In poisoning, however, it irritates the parts which eliminate it—*i.e.*, the kidneys, mouth and the bowels (chiefly the cæcum). An odor of garlic appears in the breath after the continuous exhibition of bismuth, owing to traces of tellurium contained in the bismuth. Recently several ounces of bismuth subnitrate have been given at one dose to the human to secure a skiagram of the digestive organs and also have been injected as Beck's paste to cure suppurating cavities. Poisoning has sometimes occurred following the use of such enormous doses due to the bismuth and also to the transformation of the nitrate into a nitrite. Nausea, vomiting, cyanosis, rapid pulse and respiration, and prostration have been observed in such cases. It is safer to use the subcarbonate or oxychloride when massive doses are given. Two ounces of either may be given internally to man with perfect safety.

As ordinarily used, the salts of bismuth are absolutely harmless, although formerly poisoning was not infrequent from their contamination with arsenic. The tongue and feces are stained black by bismuth salts, which are transformed into the sulphide. Bismuth, locally and mechanically, by reason of its weight and insolubility, protects and coats the mucous membrane of the digestive tract, and thus exerts a sedative, astringent and antiseptic action throughout the canal. Bismuth must, therefore, be given, to be effective, in large and frequent doses, and when the stomach is empty. For this reason the drug is not of much value in the treatment of the horse and ruminant, as a sufficient quantity cannot be used economically.

USES OF BISMUTH SUBNITRATE AND SUBCARBONATE.

External.—Bismuth subnitrate is a very good dusting powder on sores, and for moist skin diseases and ulcerated surfaces. It may be combined with zinc oxide and salol, or used in the form of an ointment in the proportion of 1 to 4. The following is an effective combination to apply to superficial wounds and raw surfaces attended with much secretion:

℞

Bismuthi subnitratis.....	50.0	℥i. 3 v.
Acidi tannici.....	25.0	3 vi.
Iodoformi	15.0	3 iv.
Carbo ligni.....	100.0	℥ iii. 3 ii.

M. et fiat pulvis

Sig. Dust on surface.

It may be employed to advantage in coryza and ozena, by insufflation into the nostrils. A paste made by boiling vaseline in an enameled jar and stirring in bismuth subnitrate, in the strength of 33 per cent., is of great value for curing fistulæ and chronic suppurating cavities when injected warm so as to completely fill them. If one injection does not cure, repeat in a week and then every 4 days for a month. The paste, while warm, is drawn up into a metal or glass syringe. In small fistulæ, as about the rectum, long flexible tips may be used to insert in the sinus. More than 100 grams should not be retained in the body (in the human) lest poisoning occur.

In old or thick-walled sinuses or abscesses there is little danger of absorption. In thin-walled and recent abscesses a ten per cent. ointment may be used. When there is indigestion and diarrhea with a marked, blue line about the gums, following injection of a large amount of bismuth, poisoning may occur.

This is stopped by injecting warm oil into the cavity and aspirating the contents some 12 hours later.

This new method of Beck's has completely revolutionized the treatment of sinuses, especially those connected with bone.

Various other suppurating cavities are cured by bismuth injections. Thus empyema, cold and tuberculous abscesses, and sinuses following operations.

The paste should cause a suppurating sinus to discharge a serous fluid.

Causes of failure are due to the presence of a foreign body or

sequestrum of bone. Or the paste has not been soft enough to enter all pockets. When large amounts of the paste are required substitute chalk for bismuth. Dermatol (bismuth subgallate) is even more efficient than the subnitrate alone as an antiseptic and astringent dusting powder.

Internal.—Bismuth is one of the best agents to relieve vomiting in dogs, owing to the soothing and sedative effect upon inflamed mucous membranes. It may be given alone or in combination with oxalate of cerium upon the tongue or in the food. It is also a very efficient agent in diarrhea in the dog, being astringent, sedative and antiseptic. Its use should be preceded by the administration of oil or calomel, in diarrhea. Bismuth is given for diarrhea in powder with salol; or in suspension with gum arabic and water, with one drop of carbolic acid to each dose of bismuth; or better, in capsules, dispensing one grain of carbolic acid and five grains of bismuth. The sedative effect upon the stomach is increased by giving the subcarbonate of bismuth with bicarbonate of sodium, while the sedative effect upon the bowels is enhanced by combining morphine with bismuth subnitrate. It is generally immaterial whether the subnitrate or subcarbonate of bismuth be selected in any given case. Bismuth salicylate is more powerful as an antiseptic than the other salts. It is useful in diarrhea, intestinal fermentation and indigestion of dogs. The drug should be given in capsules.

SECTION V.

Ferrum.

Metallic iron is official in the form of fine, bright and non-elastic wire, from which are made iron preparations and reduced iron.

Ferrum Reductum. Reduced Iron. (U. S. P.)

Synonym.—Ferrum redactum, B. P.; iron by hydrogen, Quevenne's iron, ferrum hydrogenio reductum, ferrum ope hydrogenii paratum, E.; ferrum redactum, P. G.; fer réduit par l'hydrogène, Fr.; reducirtes eisen, G.

Derivation.—Hydrogen gas is passed over freshly made and carefully washed ferric oxide in a hot and closed tube. $Fe_2O_3 + 3\ H_2 = Fe_2 + 3\ H_2O$.

Properties.—A very fine grayish-black, lustreless powder, without odor or taste; permanent in dry air; insoluble in water or alcohol.

Dose.—H., 5 i.-ii. (4.8.); C., 5 ii.-iv. (8.-15.); Sh. & Sw., gr.xx.-xxx. (1.3-2.); D., gr.i.-v. (.06-.3).

FERRI SULPHAS. Ferrous Sulphate. $Fe\ So_4 + 7\ H_2O$. (U. S. & B. P.)

Synonym.—Copperas, green vitriol, vitriolum martis purum, sulfas ferrosus, ferrum vitriolatum purum, E.; ferrum sulphuricum purum, P. G.; sulfate de fer, sulfate ferreux, Fr.; schwefelsaures eisenoxydul, G.

Derivation.—Iron wire is dissolved by boiling in diluted sulphuric acid. $Fe_2 + 2\ H_2SO_4 = 2\ Fe\ SO_4 + 2\ H_2$.

Properties.—Large, pale, bluish-green, monoclinic prisms, without odor, and having a saline styptic taste; efflorescent in dry air. On exposure to moist air the crystals rapidly absorb oxygen and become coated with brownish-yellow, basic ferric sulphate; soluble in 0.9 part of water; insoluble in alcohol.

Dose.—H., 5 i.-ii. (4.-8); C., 5 ii.-iv. (8.-15.); Sh. & Sw., gr.xx.-xxx. (1.3-2.); D., gr.i.-v. (.06-.3).

FERRI SULPHAS EXSICCATUS, Exsiccated or Dried Ferrous Sulphate. $Fe_2So_4 + 3\ H_2O$. (U. S. & B. P.)

Synonym.—Ferrum sulfuricum siccum, P. G.; sulfate de fer desséché, Fr.; entwässerte schwefelsaures eisenoxydul, G.

Derivation.—Allow ferrous sulphate, 100, to effloresce at a temperature of 104° F. Then heat on a water bath till the product weighs 65.

Properties.—A grayish-white powder, soluble in water.

Dose.—Same as sulphate.

FERRI SULPHAS GRANULATUS. Granulated Ferrous Sulphate. $Fe_2SO_4 + 7\ H_2O$. (U. S. & B. P.)

Derivation.—Dissolve ferrous sulphate, 100, in distilled water, 100, and add sulphuric acid, 5. Evaporate till the product weighs 150. Pour alcohol, 25, upon it and dry.

Properties.—Pale, bluish-green, crystalline powder.

Dose.—Same as sulphate.

FERRI CARBONAS SACCHARATUS. Saccharated Ferrous Carbonate. (U. S. & B. P.)

Synonym.—Ferrum carbonicum saccharatum, P. G.; carbonas

ferrosus saccharatus, saccharure de proto-carbonate de fer, Fr.; zückerhaltiges kohlensaures eisen, G.

Derivation.—Ferrous sulphate, 50; sodium bicarbonate, 35;

Properties.—Greenish-brown powder, without odor; sweetish sugar and distilled water. Made by solution, precipitation and washing.

Contains 5 per cent., by weight, of ferrous iodide (FeI_2).
taste; becomes oxidized on exposure to the air.

Dose.—Twice that of iron sulphate.

Massa Ferri Carbonatis. Mass of Ferrous Carbonate. (U. S. P.)

Dose.—D., gr.i.-v. (.06-.3) in pill.

Syrupus Ferri Iodidi. Syrup of Ferrous Iodide. (U. S. & B. P.)

Properties.—Transparent, pale green liquid; sweet, ferruginous taste.

Dose.—H., ʒ ss.-i. (15.-30. cc.); D., ♏ v.-xxx. (.3-2.).

Ferri Chloridum. Ferric Chloride. $Fe_2Cl_6 + H_2O$. (U. S. P.)

Synonym.—Ferrum sesquichloratum, P. G.; ferrum muriatum oxydatum, chloridum seu chloruretum ferricum, ferri perchloridum, sesquichloride (perchloride) of iron, E.; perchlorure de fer, chlorure ferrique, Fr.; eisenchlorid, G.

Derivation.—Solution of ferric chloride, 100 Gm., evaporate to 40 Gm. on water bath. Set aside to crystallize; break into pieces and keep in glass-stoppered bottles in dark.

Properties.—Orange yellow, crystalline pieces, odorless, or having a faint odor of hydrochloric acid, and a strong styptic taste; deliquescent; soluble in water and alcohol; reaction acid; not used internally.

Liquor Ferri Chloridi. Solution of Ferric Chloride. (U. S. P.)

Synonym.—Liq. ferri perchloridi, B. P. An aqueous solution of ferric chloride (Fe_2Cl_6) containing not less than 29 per cent. of the anhydrous salt, or about 10 per cent. of metallic iron.

Derivation.—Dissolve iron wire, 125, in hydrochloric acid, 680, nitric acid and water to make 1,000. (U. S. P.)

First reaction.—$Fe_2 + 4\ HCl = 2\ Fe\ Cl_2 + 2H_2$.

Second reaction.—$6\ FeCl_2 + 6\ HCl + 2\ HNO_3 = 3\ Fe_2\ Cl_6 + 2\ NO + 4\ H_2O$.

Properties.—A reddish-brown liquid, having a faint odor of hydrochloric acid; an acid, strongly styptic taste and an acid reaction.

Dose.—H. & C., ♏ ii.-iv. (8.-15.); Sh. & Sw., ♏ x.-xx. (6.-1.3); D., ♏ ii.-x. (.12-.6).

PREPARATIONS.

Tinctura Ferri Chloridi. Tincture of Ferric Chloride. (U. S. P.)

Solution of ferric chloride, 350; alcohol to make 1,000.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ♏xx.-xxx. (1.3-2.); D., ♏v.ʒi. (.3-4.)

Contains 13.28 per cent. of the anhydrous salt, or 4.58 per cent. of metallic iron.

Tinctura Ferri Perchloridi. Tincture of Iron Perchloride. (B. P.)

Dose.—Same as Tinctura Ferri Chloridi (U. S. P.)

Liquor Ferri Subsulphatis. Solution of Ferric Subsulphate. (U. S. P.)

Synonym.—Solution of basic ferric sulphate $FeO\ (SO_4)_5$, Monsel's solution, solution of persulphate of iron, E.; liquor hémostatique de Monsel, Fr.; basischschewefelsaures eisenoxydlösung, Monsel's eisenlösung, G. Contains about 13.6 per cent. of metallic iron.

Derivation.—Ferrous sulphate, 675; Sulphuric acid, 65; nitric acid and distilled water, of each a sufficient quantity to make 1,000.

Properties.—A dark reddish-brown liquid, odorless or nearly so; of an acid, strongly styptic taste and an acid reaction; miscible with water and alcohol.

Dose.—H. & C., ʒ ss. (15.); Sh. & Sw., ♏ x.-xx. (.6-1.3); D., ♏ ii.-x. (.12-.6).

It has no value for internal use.

Ferri Hydroxidum Cum Magnesii Oxido. Ferric Hydroxide with Magnesium Oxide. (U. S. P.)

(*Arsenic Antidote.*)

Solution of ferric sulphate, 40 cc.; water, 125cc. Magnesium oxide, 10 gm.; water, q.s. Keep solutions separate till ready for use; then mix.

Uses.—This preparation is used as a chemical antidote to arsenic, whereby the arsenic mass is mechanically enwrapped and converted into the insoluble arsenite. The administration of the arsenic antidote should be followed by emetics, or the stomach tube.

Dose.—Large quantities should be repeated frequently *ad libitum.*

Ferri et Potassii Tartras. Iron and Potassium Tartrate. (U. S. P.)

(*Potassio-Ferric Tartrate.*)

Synonym.—Ferrum tartaratum, B. P.; tartarus ferratus, P. G.; ferri potassio-tartras, ferrum tartarizatum, tartras ferrico-kalicus, etc., E.; tartrate de fer et de potasse, tartre martial, Fr.; weinsaures eisenoxyd-kali, eisenweinstein, G.

Properties.—Thin, transparent scales, varying in color from garnet-red to reddish-brown; without odor, and having a sweetish, slightly ferruginous taste; slightly deliquescent in the air; very soluble in water; insoluble in alcohol. Iron and potassium tartrate contains 15 per cent. of metallic iron.

Dose—D., gr.v.-x. (.3-.6).

Ferri et Ammonii Citras. Iron and Ammonium Citrate. (U. S. & B. P.)

Synonym.—Ferrum citricum ammoniatum, P. G.; ferri ammonio-citras, ferro-ammonium citricum, ammonio citrate of iron, E.; citrate de fer et d'ammoniaque (de fer ammoniacal), Fr.; citronensaures eisenoxyd-ammonium (ammoniak), G.

Properties.—Thin, transparent, garnet-red scales, without odor, and having a saline, mildly ferruginous taste; deliquescent in moist air; soluble in water; insoluble in alcohol. Iron and ammonium citrate contains 16 per cent. of metallic iron.

Dose.—D., gr.v.-x. (.3-.6).

Ferii et Quininæ Citras. Iron and Quinine Citrate. (U. S. & B. P.)

Synonym.—Chininum ferro-citricum, P. G.; citras ferrico-quinicus, citrate de fer et de quinine, Fr.; citronensaures eisen chinin, G.

Properties.—Thin, transparent scales, of a reddish-brown color, without odor, and having a bitter, mildly ferruginous taste; slowly deliquescent in damp air; slowly but completely soluble in cold water and but partially soluble in alcohol. Iron and quinine citrate contains 11.5 per cent. of quinine and 13.5 per cent. of metallic iron.

Dose.—As below.

Ferri et Quinine Citras Solubilis. Soluble Iron and Quinine Citrate. (U. S. P.)

Occurs in thin, greenish-yellow, transparent scales. Very rapidly and completely soluble in cold water. Soluble quinine and iron contains 11.5 per cent. of quinine and 13.5 per cent. of metallic iron.

Dose.—D., gr.v.x. (.3-.6.)

General Action of Iron and its Salts.

External.—The local action of iron salts—like those of the other heavy metals—depends upon coagulation of the proteids of the tissues through the formation of albuminate compounds with the metal and the setting free of the acid ions of the salt. Certain salts of iron, depending upon their acid constituent, are strongly astringent and more or less irritant—as the chloride, perchloride, sulphate, persulphate, and nitrate. They contract tissue by coagulating albumin, when applied to raw surfaces or mucous membranes, and through this means, by compressing the blood-vessels from without and plugging them from within with clotted blood, arrest hemorrhage. The astringent salts may also induce some contraction of the vessels besides. Iron—in the form of liquor ferri chloridi or liquor ferri subsulphatis—is the most powerful of the metallic hemostatic agents we possess.

Internal.—Alimentary Canal.—Iron is a food rather than a medicine. It exists as a natural constituent of vegetable foods and of the body, and is found particularly in the hemoglobin of the blood—to the extent of about half an ounce in that of the horse. There is a

sufficient quantity in the food to support healthy animals. If iron is ingested by a normal animal in ordinary doses, it has little effect unless continued for a long time in considerable quantity, when it may produce indigestion and constipation. Large doses of irritant and astringent salts, as the perchloride, may induce gastroenteritis by local irritation.

Internally in the stomach the iron salts behave as they do externally. Acid ions are set free from the iron salt and the metal combines with albumin. The liberation of the acid ion leads to an astringent action and, if large doses are ingested, actual irritation. The degree of astringency is due to the preparation also. Thus ferric chloride is especially astringent because of the case of dissociation and corrosive action of the HCl ion. Ferrous sulphate is only a little less so; while reduced iron, the oxide, carbonate, double salts and salts of the vegetable acids (citrates, acetates and tartrates), and albuminates, are very slightly or not at all astringent. In the case of the salts of the organic acids and double salts the acid ions are but slowly dissociated, and in that of the albuminate there is no acid to be freed. Acid salts, as the sulphate, are more suitable for the horse than the dog. Iron may blacken the tongue from formation of the sulphide. In the stomach all forms of iron are converted into chlorides, by the HCl of the gastric juice, and then probably into albuminates.

Iron is naturally absorbed from the organic compounds of the metal existing in the nucleoalbumins of food, and, either existing in this form or when given in medicine in the inorganic state, it is probably absorbed chiefly from the duodenum as the albuminate. But in any event the greater portion escapes from the bowel unabsorbed. The route which iron follows, after absorption, has been quite accurately ascertained by many experiments. It is taken up from the duodenum by the epithelial cells and leucocytes and carried by the blood into the spleen, in which it is first deposited. From thence, through the blood, it is conveyed to the liver and bone marrow. If it is needed for blood-making it is transformed by many steps into hemoglobin in the liver. But if it is not so needed it is eliminated by the large intestine and escapes from the bowel in the form of the sulphide and albuminate—the feces turning dark on exposure to air.

Constitutional Action.—This is not observed unless iron is given intravenously. A salt which will not coagulate blood and which will free its iron ion must be employed—as the tartrate of iron and sodium. Large doses thus given cause vomiting, purging, convulsions, dyspnea and failure of respiration. Albumin and casts may appear in the urine. In other words, gastrointestinal and renal

irritation succeeded by stimulation and final depression of the central nervous system.

The numerous compounds of iron now manufactured by pharmaceutical concerns under the name of albuminates and peptonates, and supposed to imitate the natural organic forms of iron found in the blood and liver, are not superior to the inorganic salts in many cases and are worthless in others. Some—as ferratin and carniferrin—are more readily absorbed and less irritating than many of the inorganic preparations and might be of some value in canine practice.

Blood.—In anemia iron is mainly of worth by furnishing building material for blood. It may also stimulate the blood-making organs and in this way perhaps increase the number of red corpuscles. The leucocytes are also somewhat augmented. Iron increases the power of the red corpuscles to hold and carry oxygen from the lungs to the tissues, and to transform it into ozone. Iron is then indirectly an oxidizing agent, stimulating tissue change and vital activity.

Elimination.—Iron is chiefly excreted by the intestinal mucous membrane, however administered, yet it is also found in minute amounts in the urine, bile, saliva, sweat and tears.

Summary.—Iron is essentially a blood tonic and restorative, increasing the number of red blood corpuscles, the amount of hemoglobin. and aiding nutrition. Externally it is an astringent, styptic and stimulant.

Uses External.—Liquor ferri chloridi and liquor ferri subsulphatis are sometimes used to stop bleeding from wounds or natural cavities of the body. They may be injected, applied by swab, or on absorbent material, which is packed into the wound or cavity. As a local application in pharyngitis, we use 1 part of the solution of ferric chloride with 4 parts of glycerin. In the same strength, diluted with water, the chloride may be injected into the uterus to stop hemorrhage. Again, a solution, in the strength of 2 drachms to the pint of water, is employed as an enema to destroy ascarides. The objection to these solutions of iron is that they form heavy, nasty, tenacious clots, when employed to arrest hemorrhage, and the clots are apt to decompose and favor sepsis. Therefore they should not be used if other means, as ligature, pressure, heat or cold, or adrenalin chloride can be utilized.

Internal.—Reduced iron is one of the best preparations for dogs. It is commonly administered in pill, and often with other tonics, as strychnine, quinine, and arsenic. Reduced iron is non-irritating,

which can be prescribed to the larger animals. The other form is the tincture of ferric chloride. The sulphate is more astringent and irritating than some of the other iron salts, but does not usually cause constipation in the horse. Indeed, when constipation is due to loss of tone in the lower bowel, small doses, by their local stimulant action, may actually assist peristalsis. The dried ferrous sulphate is prescribed to horses in anemia, and is the most common constituent of tonic powders. It is frequently combined with powdered gentian, nux vomica, arsenic, and bicarbonate of sodium. Sodium bicarbonate is useful in indigestion and lessens the astringent action of sulphate of iron in neutralizing the acid set free from the salt. Nux vomica relieves constipation. A common and useful preparation for the horse is as follows:

℞
Sodii bicarbonatis.
Pulv. nucis vomicæ .....āā 3 ii.
Ferri sulphatis exsicc ..... 3 i.
M. et f. pulv. l. Dispense pulv. tales no. xxx.
S. Give one powder on the feed three times daily.

Ferrous sulphate is given in anemia secondary to chronic indigestion, intestinal parasites, leucorrhea, ozena, albuminuria, and in convalescence from acute diseases. Ferrous sulphate is in itself an anthelmintic, but, to get its full effect when used for this purpose in the treatment of round worms in the horse (ascarides), it should be given twice daily on the food for ten days, and then a pint of linseed oil containing three ounces of oil of turpentine is to be administered to complete the cure. In convalescence, iron may well be preceded by alcohol and bitters. Large doses of iron sulphate are indicated in hemorrhage from the bowels, if unassociated with acute inflammation, as in purpura. In the latter disease, sulphuric acid is a synergistic remedy.

The saccharated ferrous carbonate may be given horses if they will not voluntarily take the sulphate of iron on their food. It is a useful, mild, non-astringent preparation for dogs, and may be given in powder, or the mass may be dispensed in pills.

The iodide of iron is thought to be of benefit in man in scrofulous conditions, but as these states do not commonly occur in horses and dogs, the drug is chiefly of value, in the form of the syrup, in rickets, and acts almost as a specific in that form of polyuria afflicting horses during hot weather, and also in mild cases of anasarca and dropsy. The syrup should be prescribed undiluted and water should be added just before administering the preparation. If prescribed

with water, the syrup will undergo decomposition if allowed to stand for any length of time. The syrup must be a fresh preparation, else free iodine is formed in it, which will blacken the buccal mucous membrane. When the action of iodine and iron is desirable, it is often better to prescribe them separately.

The tincture of ferric chloride is a very powerful preparation. It contains free hydrochloric acid. Alcohol constitutes three-quarters of its bulk, and there are also some traces of ether. It was formerly thought to be hydrochloric ether, arising from the action of the contained muriatic acid on the alcohol of the preparation; but Weir Mitchell has shown it to be nitrous ether. Ferric chloride is of itself diuretic, apart from any action of nitrous ether in the tincture. The free acid aids digestion in the stomach. The tincture of ferric chloride is locally stimulant and astringent, and generally aids digestion; is diuretic, and in large doses, owing to the alcohol which it contains, is somewhat stimulating. The tincture is, accordingly, particularly valuable in anemia, dependent upon chronic indigestion in horses and cattle, and in that occurring in convalescence from acute diseases. In such conditions, the preparation stimulates appetite, digestion and renal activity. When given by the mouth, the tincture of the chloride of iron is of local benefit in pharyngitis, combined with chlorate of potash, glycerin and water. Also in membranous croup of fowl (roup) in 10 m. doses; and of foals, calves and pigs (5 ss.), with an equal amount of potassium chlorate. It is prescribed in intestinal hemorrhage (dried ferric subsulphate or Monsel's salt given in 1 to 2 drachm doses in gelatine capsules is more effective for this purpose in the larger animals), but there is no remote astringent or styptic effect exerted upon the vessels or tissues. Small doses of the tincture of ferric chloride may be safely dropped, undiluted, upon the tongue of horses or cattle from a small bottle used as a measure. It is frequently conjoined with alcohol and mineral acids. The fluidextract of quassia or calumba are often combined with the tincture of ferric chloride without incompatibility.

Iron and ammonium citrate and iron and potassium tartrate are mild, non-astringent preparations, suitable for dogs and given in pill. The soluble citrate of iron is sometimes given subcutaneously every other day: H., 3 ss.; D., gr.i. in aqueous solution.

Iron and quinine citrate is a useful combination for dogs, dispensed in pill. It is often employed in canine distemper and chorea. No drug is given more indiscriminately than iron. Pallor is a poor indication. Blood examination is the only safe guide.

Manganum.

(*Manganese is not used in Medicine in the metallic state.*)

Potassii Permanganas. Potassium Permanganate. $KMnO_4$ (U. S. & B. P.)

Synonym.—Kali hypermanganicum crystallisatum, P. G.; hypermanganas potassicus S. kalicus, permanganate of potash, E.; permanganate de potasse, Fr.; uebermangansaures kali, G.

Derivation.—Caustic potash, chlorate of potassium and black oxide of manganese are fused together. $6\ KHO + KClO_3 + MnO_2 = 3\ K_2MnO_4 + KCl + 3\ H_2O$. The manganate of potassium is boiled with water till the color changes to purple and the permanganate is formed. $3\ K_2MnO_4 + 2\ H_2O = 2\ KMnO_4 + 4KHO + MnO_2$. The liquid is neutralized with carbonic dioxide gas and evaporated.

Properties.—Slender, monoclinic prisms, of a dark purple color, odorless, and having a taste at first sweet, but afterwards disagreeable and astringent; permanent in dry air; soluble in 15 parts of water; undergoes decomposition with alcohol; reaction neutral.

Incompatibles.—It is very readily deoxidized in the presence of organic matter.

Dose.—H., gr.xv.-xx. (1.-1.3) in one pint of water; D., gr.i.-ii. (.06-.12); in pill, or tablet, with kaolin.

ACTION OF POTASSIUM PERMANGANATE.

External.—Potassium permanganate, like hydrogen dioxide, is a powerful oxidizing agent. It quickly parts with its oxygen in contact with organic matter, largely in the form of ozone, and is broken up into black oxide of manganese and potassa. Solutions, which are of a purple hue, change into a dark brown color when this transformation occurs, and are no longer of any medicinal value. This action is exceedingly rapid and transient, and its effects correspondingly so on the tissues. For this reason, and because bacteria are so combined with organic matter in the tissues, its action is largely exerted on the latter, and potassium permanganate is, therefore, a better antiseptic than disinfectant. The antiseptic action of potassium permanganate is, moreover, quite superficial, since it parts with its oxygen so soon as it comes in contact with the albumin

of the tissues. Outside of the body, permanganate of potash is a disinfectant, but it is too expensive for general purposes. In powder it is slightly caustic, owing to the potassa set free in its decomposition; and in solution is stimulant to the tissues. A solution of permanganate of potash is a deodorizer when in contact with putrid and decomposing matter, but is not of the slightest value as a deodorizer and disinfectant to premises when simply standing in vessels, as frequently advised. There is no danger from absorption of potassium permanganate when applied to the body.

Uses Internal.—Potassium permanganate is occasionally used in human medicine in dyspepsia and flatulence, for its antiseptic action, and in obesity. It is supposed to resemble iron in its effects, and has been used in ammenorrhea associated with anemia. Moor, of New York, has shown that potassium permanganate is the best chemical antidote for morphine or opium, chemically destroying them by oxidation; 10 to 15 grains may be given to dogs in 8 ounces of water immediately after poisoning. Horses may be given 2 drachms of permanganate of potash in 5 pints of water. In case morphine has been swallowed, solutions of potassium permanganate should be acidulated with vinegar, or diluted sulphuric acid, in order to form soluble compounds in the digestive tract. After morphine or opium have been absorbed into the blood, it is said that potassium permanganate is also antidotal when injected subcutaneously. It is difficult to see, theoretically, how this can be the case, and practically has been proven not to be so.

Uses External.—Potassium permanganate is a valuable antiseptic and deodorizer in solutions varying in strength from one-tenth of 1 per cent. to 4 per cent., and is used in the treatment of sores, wounds, ulcers, abscess, caries, gangrene, fetid ozena, otorrhea, and leucorrhea. In the stronger solution it is stimulant, as well as antiseptic. It is a useful agent in stomatitis and sore throat, when applied locally by means of a swab. The powder is employed as a caustic upon ulcers. Potassium permanganate is one of the best agents with which to sterilize the hands before operating. A saturated solution is to be recommended for this purpose, and the stains may be removed from the hands by washing them in a saturated solution of oxalic acid, or in a dilute solution of hydrochloric acid.

Potassium permanganate is a test for impure water in changing color in the presence of organic matter. Two ounces of a 1 per cent. solution will clarify and deodorize 100 gallons of stale and putrescent rain water.

SECTION VI.

Hydrargyrum.

MERCURY. Quicksilver.

Synonym.—Mercurius vivas, argentum vivum, E.; mercure, vif-argent, Fr.; quecksilber, G.

Derivation.—Cinnabar, the native sulphate, is roasted or distilled with lime, and condensed.

Properties.—A shining, silver-white metal, without odor or taste; liquid at ordinary temperatures, and divisible into spherical globules; insoluble in the ordinary solvents; boils at 675° F., and is completely volatilized; spec. gr., 13.5584. When cooled to 38.88° F., it forms a ductile, malleable mass.

PREPARATIONS CONTAINING METALLIC MERCURY.

I.—Hydrargyrum cum Creta. Mercury with Chalk. (U. S. & B. P.)

Synonym.—Gray powder.

Mercury, 38 gm.; honey, 10 gm.; prepared chalk, 57 gm.; water, sufficient quantity to make 100 gm. (U. S. P.)

Mercuric oxide becomes developed by keeping, making the powder more active.

Properties.—A light gray, rather damp powder, free from grittiness, without odor, and having a slightly sweetish taste. Contains mercury in fine division by shaking the ingredients together.

Dose.—Foals and calves, gr.x.-xv. (.6-1.); D., gr.i.-x. (.06-.6).

II.—Massa Hydrargyri. Mass of Mercury. (U. S. P.)

Synonym.—Pilula hydrargyri, B. P.; blue mass, blue pill, pilulæ cœruleæ, E.; pilule de mercure, Fr.; mercurial pillen, G.

Mercury, 33 gm.; glycyrrhiza, 10 gm.; althæa, 15 gm.; glycerin, 9 gm.; honey of roses, 33 gm. Contains 33 per cent. of mercury in a state of fine division. (U. S. P.)

Dose.—D., gr.i.-x. (.06-.6).

III.—Unguentum Hydrargyri. Mercurial Ointment. (U. S. & B. P.)
(Blue Ointment.)

Synonym.—Pommade mercurielle, pommade Napolitaine, Fr.; graue quecksilbersalbe, G.

Mercury, 500 gm.; lard, 250 gm.; suet, 230 gm.; oleate of mercury, 20 gm. Contains 50 per cent. of mercury. (U. S. P.)

Hydrargyri Oxidum Rubrum. Red Mercuric Oxide. HgO. (U. S. & B. P.)

Synonym.—Hydrargyrum oxydatum rubrum, P. G.; hydrargyri-nitrico-oxydum, mercurius corrosivus (præcipitatus) ruber, oxydum hydrargyricum, peroxide of mercury, red precipitate, mercuric oxide, E.; deuto-oxyde (peroxyde) de mercure, oxyde mercurique, précipite rouge, poudre de Jean de Vigo, Fr.; rothes quecksilberoxyde, rother präcipitat (quecksilber-präcipitat), G.

$3\ Hg_2 + 16\ HNO_3 = 6\ Hg\ (NO_3)_2$. (Mercuric nitrate) + $4\ NO + 8\ H_2O$.

Rub mercuric nitrate with metallic mercury and heat.

$2\ Hg\ (NO_3)_2 + Hg_2 = 4\ HgO + 2\ N_2O_4$.

Derivation.—Dissolve mercury in diluted nitric acid.

Properties.—Heavy, orange-red, crystalline scales, or a crystalline powder; odorless, and having a somewhat metallic taste; permanent in the air; almost insoluble in water; insoluble in alcohol.

PREPARATION.

Unguentum Hydrargyri Oxidi Rubri. Ointment of Red Mercuric Oxide. (U. S. & B. P.)

Synonym.—Red precipitate ointment. Red murcuric oxide, 10; water, 10; hydrous wool-fat, 40; petrolatum, 40. (U. S. P.)

Hydrargyri Oxidum Flavum. Yellow Mercuric Oxide. HgO (U. S. & B. P.)

Synonym.—Hydrargyrum oxydatum via humida paratum, P. G.; hydrargyrum oxydatum præcipitatum (vel flavum) precipitated oxide of mercury, E.; oxyde de mercure jaune (précipité), Fr.; präcipitirtes (Gelbes) quecksilberoxyde, G.

Derivation.—Precipitate an aqueous solution of mercuric chloride, 100, with caustic soda, 40: $HgCl_2 + 2\ NaOH = HgO + 2\ NaCl + H_2O$.

Properties.—A light orange yellow, amorphous, heavy, impalpable powder; odorless, and having a somewhat metallic taste; permanent in the air, but turning darker on exposure to the light; almost insoluble in water; insoluble in alcohol.

PREPARATIONS.

Unguentum Hydrargyri Oxidi Flavi. Ointment of Yellow Mercuric Oxide. (U. S. P.) B. P. 2 per cent.

Yellow mercuric oxide, 10; water, 10; hydrous wool-fat, 40; petrolatum, 40.

Oleatum Hydrargyri. Oleate of Mercury. (U. S. P.)
Hydrargyri Oleas. (B. P.)

Yellow mercuric oxide, 25; water, 25; oleic acid to make 100. (U. S. P.)

Hydrargyri Chloridum Corrosivum. Corrosive Mercuric Chloride. $HgCl_2$. (U. S. P.)

(*Corrosive Chloride of Mercury, Corrosive Sublimate.*)

Synonym.—Hydrargyri perchloridum, B. P.; hydrargyrum bichloratum corrosivum, P. G.; hydrargyrum muriaticum corrosivum, hydrargyri bichloridum, sublimatus corrosivus, sublimatum corrosivum, mercurius sublimatus corrosivus, chloruretum (chloretum) hydrargyricum, perchloride of mercury, bichloride of mercury, E.; Deutochlorure de mercure, sublimé corrosif, chlorure mercurique, Fr.; ætzendes quecksilberchlorid, ætzender quecksilbersublimat, G.

Derivation.—Heat a mixture of mercuric sulphate, 20; sodium chloride, 16; manganese dioxide, 1. $HgSO_4 + 2\ NaCl + MnO_2 = HgCl_2 + Na_2SO_4 + MnO_2$. The bichloride sublimes and is condensed.

Properties.—Heavy, colorless, rhombic crystals, or crystalline masses; odorless, and having an acrid and persistent metallic taste: permanent in the air; soluble in 13 parts of water and in 3 parts of alcohol.

Incompatibles.—It is incompatible with most substances.

Dose.—H. & C., gr.v.-vii. (.3-.5); Sh. & Sw., gr.ii. (.12); D., gr.$\frac{1}{30}$-$\frac{1}{8}$ (.002-.008).

Hydrargyri Chloridum Mite. Mild Mercurous Chloride. HgCl (U. S. P.)

(*Calomel, Mild Chloride of Mercury.*)

Synonym.—Hydrargyri subchloridum, B. P.; hydrargyrum chloratum mite, P. G.; hydrargyri chloridum, hydrargyrum

chloratum mite, P. G.; hydrargyri chloridum, hydrargyrum chloratum (muriaticum) dulce, mercurius dulcis, calomelas chloruretum (chloretum) hydrargyrosum, subchloride (protochloride) of mercury, E.; protochlorure (sous-muriate) de mercure, calomèle, Fr.; quecksilberchlorür, calomel, G.

Derivation.—Heat mercurous sulphate and sodium chloride. Calomel sublimes. $Hg_2\ SO_4 + 2\ Na\ Cl = 2\ HgCl + Na_2SO_4$.

Properties.—A white, impalpable powder; odorless and tasteless; permanent in the air; insoluble in water or alcohol. When strongly heated it is wholly volatilized without melting.

Dose.—H., 3 ss.-i. (2.-4.); C., 3 v.-vi. (20.-24.); D., gr.ss. (.03), in divided doses; D., gr.iii.-v. (.2-.3) in single doses.

PREPARATION.

Pilulæ Catharticæ Compositæ. Compound Cathartic Pills. (U. S. P.)

Compound extract of colocynth, 80; calomel, 60; resin of jalap, 20; gamboge, 15; diluted alcohol, Q. S. to make 1.000 pills.

Dose.—D., pill 1 to 3.

Hydrargyri Iodidum Rubrum. Red Mercuric Iodide. HgI_2. (U. S. & B. P.)

(*Biniodide of Mercury, Red Iodide of Mercury.*)

Synonym.—Hydrargyri biiodatum rubrum, P. G.; deutoioduretum (biniodidum) hydrargyri, mercurius iodatus ruber, iduretum hydrargyricum, E.; deut-iodure (bi-iodure) de mercure, iodure mercurique, Fr.; rothes jodquecksilber, quecksilberjolid, G.

Derivation.—Mix aqueous solutions of corrosive mercuric chloride, 40gm., and potassium iodide, 50gm. The red iodide is precipitated. Filter, wash and dry. $HgCl_2 + 2\ KI = HgI_2 + 2\ K\ Cl$.

Properties.—A scarlet-red, amorphous powder; odorless and tasteless; permanent in the air; almost insoluble in water; soluble in 116 parts of alcohol.

Unguentum Hydrargyri Nitratis. Ointment of Mercuric Nitrate (Citrine Ointment). (U. S. & B. P.)

Mercury, 70 gm.; nitric acid, 175 gm.; lard, 760 gm. (U. S.)

Properties.—A lemon-yellow ointment.

HYDRARGYRUM AMMONIATUM. Ammoniated Mercury. $HgNH_2Cl$. (U. S. & B. P.)

(*White Precipitate, Mercuric Ammonium Chloride.*)

Synonym.—Hydrargyrum præcipitatum album, P. G.; hydrargyrum amidato-bichloratum (ammoniato-muriaticum), hydrargyri ammonio-chloridum, mercurius præcipitatus albus, E.; oxychlorure ammoniacal de mercure, mercure précipite blanc, Fr.; weisse quecksilber-präcipat, quecksilberchloridamidid, G.

Derivation.—Mix an aqueous solution (1 to 20) of corrosive mercuric chloride, 2000, with ammonia water, 150.

Properties.—White, pulverent pieces, or a white, amorphous powder, without odor, and having an earthy, afterwards styptic and metallic taste; permanent in the air; almost insoluble in water or in alcohol.

PREPARATION.

Unguentum Hydrargyri Ammoniati. Ointment of Ammoniated Mercury. (U. S. & B. P.)

Synonym.—White precipitate ointment. Ammoniated mercury, 10; White petrolatum, 50; hydrous wool-fat, 40. (U. S. P.)

GENERAL ACTION OF MERCURY AND ITS SALTS.

External.—The salts of mercury are antiseptic, germicidal, irritant and—in the case of the soluble salts—caustic, when applied to raw surfaces or mucous membranes. Corrosive sublimate is one of the slowest acting, most powerful and frequently used antiseptics. The germicidal action of mercury salts is due to their habit of combining with albumin wherever it exists and forming the albuminate of mercury. Thus they act on bacteria and in so doing destroy germ life. The caustic action of the soluble salts of mercury may be explained by the fact that when the salts are dissociated by contact with the tissues the metallic and acid ions are corrosive. Moreover, like the other salts of the heavy metals, they precipitate the proteids of the tissues with which they come in contact, but, unlike them, the mercury albuminate thus formed is soluble to some extent in the fluids of the body and therefore does not protect the surface from the further action of the salt. The antiseptic effect of corrosive sublimate is lessened by this action since the salt is decomposed in contact with albumin and the coagulated proteid prevents

it from reaching germs. By the addition of salt, hydrochloric or tartaric acid to solutions of corrosive sublimate the union of mercury with albumin is materially prevented and such combination (with tartaric acid) is provided in the tablets sold for surgical purposes.

Corrosive sublimate is more irritant to the tissues than carbolic acid, creolin or lysol, and cannot penetrate raw surfaces so well to reach germs (on account of its coagulating proteids), and cannot be used in contact with metallic instruments since mercury is deposited upon them through decomposition of this salt. The salts of mercury kill the lower forms of animal as well as vegetable life, and are valuable in the treatment of parasitic skin diseases. As a rule, antiseptics relieve itching, and the mercury salts are often used to combat this condition. Mercury and its salts are absorbed when rubbed into the unbroken skin, particularly when in combination with oil or grease.

Metallic mercury and its salts (notably the iodide), when rubbed well into the skin with fat, are thought to aid the absorption of inflammatory exudates in underlying parts.

Internal.—The irritant salts of mercury, as the bichloride, iodide, nitrate, and some of the oxides, in large doses, produce gastroenteritis, vomiting, colic, bloody diarrhea, anuria, or urine holding albumin and casts, collapse and death. The white of egg is an antidote to corrosive sublimate, forming an insoluble albuminate. Emetics, or the stomach tube, should be used in case vomiting is not spontaneous.

The use of mercury, or any of its compounds, if continued for any considerable time, either internally or externally, in such a way as to lead to absorption, may cause a chronic form of poisoning or mercurialism. This condition is characterized by fetor of the breath and soreness of the gums, making mastication painful. The gums are swollen and bleed easily; the tongue swells and salivation ensues. The teeth become loosened, the salivary and parotid glands enlarge, the temperature is elevated, and if the condition continues, there are: ulceration of the mouth (due to irritation produced by mercury eliminated in the saliva), necrosis of the jaw, general weakness, a watery condition of the blood, edema, anemia and cachexia, prostration and death. Local poisoning, as exhibited by paralysis of the hand and forearm, has occurred in a man who applied the ointment of red iodide of mercury to cattle. There is a tendency for mercury to accumulate in the liver and kidneys, chiefly, and also in the tissues generally, when given in large doses, or in smaller doses when continued for a considerable period.

The prevailing fashion of administering calomel in small and repeated doses may lead to mercurialism if purgation does not occur.

Stomach and Intestines.—Calomel and preparations of metallic mercury are most commonly used for their action on the digestive tract. Exactly what chemical changes they undergo is uncertain. Calomel was thought to be converted into mercuric chloride in the stomach, but this appears to be improbable. It is also surmised that the alkaline juices in the duodenum convert calomel into the gray oxide. Sufficient evidence of this is lacking. It is more probable that these insoluble preparations do not remain long enough in the stomach to be irritating (though vomiting is occasionally caused by calomel), but exert an irritating and therefore purgative effect in the bowels owing to some of the mercury combining with proteids of the intestinal mucous membrane. Some of the preparation is thus absorbed, as an albuminate of mercury, while the larger portion is swept out with the feces. Calomel and mercuric chloride are also intestinal antiseptics.

The mercurial purges have always enjoyed a great reputation in the treatment of so-called biliousness and torpid liver, the supposition being that they stimulated the liver and flow of bile. But experiments on man and animals show that they exert no apparent effect on the liver or biliary secretion. Their indubitable efficacy is due to their cathartic and intestinal antiseptic action, as such conditions (biliousness, etc.) are not owing to liver disorder but to indigestion.

The purgative action of calomel and mercury is assisted by salines, which increase the amount of fluid in the bowels, and aid in the expulsion and prevent the absorption of mercury. The saline should be given four hours after the administration of calomel to cattle.

Blood and Metabolism.—It is stated that calomel may be absorbed unchanged from the intestines by leucocytes to some extent. It is probable, however, that mercury preparations are chiefly absorbed as albuminates and even metallic mercury is oxidized, when in contact with the tissues, and absorbed. Small doses of mercury apparently increase the nutrition and weight of healthy animals and also the hemoglobin and red corpuscles. Mercury is sometimes called an antiphlogistic, as it has been supposed to combat the effect of inflammations. A part of this result may be attributed to the antiseptic action of the salts of mercury in the intestines by preventing fermentation and absorption of toxic material. For want of a better term to explain the beneficial actions of mercury on the tissues, that vague term "alterative" is frequently applied. Mercury (and calomel in particular) is diuretic, stimulating the secreting cells of the kidneys, and increasing the amount of urine.

Elimination.—Mercury is eliminated very slowly, mainly by the cecum and colon (after its absorption), but also by the kidneys, liver, salivary glands, and, in fact, by every conceivable channel. In thus stimulating the eliminative activities of the various glands, mercury has been termed a deobstruent. It has been surmised that its alterative effect depends, in part, upon this action in stimulating —to use the old term—the emunctories.

SUMMARY OF ACTIONS OF MERCURY AND ITS SALTS.

External.—Antiseptic, germicide, irritant, caustic, parasiticide, antipruitic and sorbefacient.

Internal.—Antiseptic, purgative, antiphlogistic, alterative and diuretic (calomel).

USES OF MERCURY AND ITS SALTS.

Hydrargyrum cum creta is similar to calomel in its effects, but very much milder, unless it contains the black oxide of mercury, when its action is much intensified. The same may be said of massa hydrargyri. Either preparation may be given dogs as a laxative in indigestion with vomiting and diarrhea; or to foals and calves (in milk or gruel) with intestinal indigestion and diarrhea, particularly if accompanied with jaundice. The oleatum or unguentum hydrargyri are rubbed into the skin to cause resolution of chronic inflammatory swellings, and also to kill animal and vegetable parasites. As the former action is due to absorption, large quantities will lead to poisoning when applied over an extensive surface. We can use other and safer remedies, as creolin, tar or sulphur ointment, for parasiticides. One should not employ an amount of blue ointment greater than 1 ounce for the larger animals; 3 drams for sheep; and 20 to 40 grains for dogs. Blue ointment is commonly diluted with 3 or 4 parts of lard. It is to be remembered in this connection that grease alone will kill lice and other parasites on the skin. On account of their sorbefacient properties, the oleate and blue ointment of mercury are applied over chronically enlarged glands, swollen joints, and thickened tendons. In view of their parasitic action, these preparations are employed to kill the fungus of favus and ringworm, and to destroy lice and the acari of mange, when inhabiting circumscribed areas. Itching in skin diseases, as chronic eczema and psoriasis, is relieved by either blue ointment or the oleate of mercury.

HYDRARGYRI OXIDUM RUBRUM ET FLAVUM.

The official ointments of the red and yellow mercuric oxides are prescribed, as stimulant and antiseptic preparations, in chronic conjunctivitis, corneal ulcers (gr. i.-ii. of the yellow oxide to ʒ i. of vaseline), granular lids and scaly skin diseases. They are also employed on indolent ulcers, swollen glands and old granulating surfaces. When used on mucous membranes, or raw surfaces, the official ointments should be diluted with equal parts of lard.

HYDRARGYRI CHLORIDUM CORROSIVUM.

External.—Corrosive sublimate is of value mainly as an antiseptic on the unbroken skin. It is germicide in solutions containing 1 part to 500, or 1000, of water. Applied to mucous membranes, or raw surfaces, it is antiseptic in solutions varying in strength from 1-10,000 to 1-1,000.

In the larger cavities of the body, as the vagina, solutions should not be used in strength greater than 1-5000 or 1-3000. Experiments by Harrington and Walker go to show that corrosive sublimate is much less active than commonly believed. A 1-1000 solution requires more than ten minutes' contact to kill common forms of pus cocci, so that dipping the hands for a few seconds in such solutions does more harm than good in inducing a false security which does not exist. They conclude by saying that, as the result of their experiments, "corrosive sublimate in any of the strengths commonly employed is a much overrated disinfectant, and under the best of conditions is so uncertain in its action that it would be of advantage to abandon its use altogether in surgery." Post & Nicoll wholly endorse this result. They find tinc. iodine, alcohol (over 50 per cent.), tinc. green soap, and 5 per cent. carbolic acid kill all bacteria in less than 1 minute. 1.5 per cent. sol. of lysol kills most germs within one minute, while 1-500 corrosive requires more than 10 minutes to kill almost any pathogenic microörganisms. These men are known to be careful and trustworthy investigators and their findings agree with the results obtained by many great surgeons. In view of the ease with which corrosive sublimate combines with albumin, it is best not to rely upon this agent for wound disinfection, but to employ normal salt solution for cleansing, followed by the hydrogen dioxide. It is only fair to state, however, that corrosive sublimate is still regarded as the antiseptic sheet anchor by many good surgeons for the irrigation of infected wounds and cavities, and for skin disinfection.

For hand and skin disinfection Harrington's solution * of corrosive sublimate is perhaps the most effective of any in existence.

Mercuric bichloride, even in the weaker solution, is too damaging to the serous membrane of the peritoneal cavity, and there is too much danger of absorption to warrant us in using it in intra-abdominal operations. As a caustic, saturated solutions are injected into fistulous tracts: *e.g.*, fistulæ of the withers, "quittor" and "poll evil," to destroy their so-called pyogenic membranes, and hasten repair. There is not much danger of absorption when used in this way.

Corrosive sublimate is very useful as a parasiticide, in destroying lice, ringworm and the fungus of favus, in solution (1-500 on the unbroken skin). It also relieves itching in pruritus, prurigo and urticaria, but is generally inferior to carbolic acid in this respect. Apart from the body, corrosive sublimate in solution 1-500 or 1-1000 is one of the cheapest and most effective disinfectants for premises infected with the contagion of glanders, anthrax, etc. The walls and floors of stables (after thorough cleansing and washing with soft soap and boiling water), clothing and all paraphernalia, not metallic, can be disinfected by washing or soaking in solutions of bichloride. Before operations, the operative field should be sterilized by scrubbing with green soap and then with Harrington's solution, after the hair has been shaved from the part. During an operation, irrigation with corrosive (1-3000) solution or boiled normal solution is commonly practised. In epizoötic abortion, in addition to quarantining the diseased animals, their discharges and the premises should be disinfected, and both the well and sick female animals should be washed twice daily about the genital regions with a solution of corrosive sublimate. Yellow wash, made by the addition of 30 gr. of mercuric bichloride to 1 pint of lime water, is sometimes employed as a stimulant application in chronic eczema, and to relieve itching. It contains the yellow oxide of mercury. In purulent conjunctivitis, frequent irrigation with a 1-1000 solution of corrosive sublimate is of the greatest service.

Internal.—Corrosive sublimate is of value in minute doses as a blood tonic, and is recommended as an antiphlogistic agent in inflammatory diseases of serous membranes, as pleuritis, meningitis, and arthritis. It is probably inferior to calomel for this purpose. We at least know that the calomel is an efficient cathartic in inflammatory diseases.

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* Harrington's solution consists of: Commercial alcohol (94 per cent.), 640 c.c.; commercial hydrochloric acid, 60 c.c.; corrosive sublimate, 0.8 gm. It is the most powerful preparation for skin disinfection known (except tinc. of iodine), rendering the skin sterile in most cases after application for two minutes.

Mercuric bichloride is employed as an intestinal antiseptic in the treatment of dysentery and diarrhea with mucous or vile smelling discharges. In these conditions, irrigation of the rectum with a 1-5000 solution is of advantage. This solution should be drained off through the rectal tube and followed by an injection of plain boiled water.

Administration.—Corrosive sublimate is given in the form of a pill or ball. If exhibited in solution to the large animals, it must be diluted with 2 quarts of water.

HYDRARGYRI CHLORIDUM MITE.

External.—Calomel is of use in chronic eczema when applied over small patches in its pure state, or as "black wash." The latter consists of one drachm of calomel in one pint of lime water, forming the black oxide of mercury, and is a very efficient preparation to relieve itching and promote recovery in chronic eczema, by mild stimulation. Calomel is of benefit when blown into the eye once or twice a week, stimulating and hastening absorption of opacities of the cornea following keratitis. It is a good agent to arrest thrush when worked up into the commisure of the hoof, between the frog and the bars, and retained in place by oakum packing.

Internal.—Calomel is a purgative, intestinal antiseptic, diuretic and alterative. It is also used for its remote antiphlogistic effects. It is particularly adapted to dogs, and is given in a single dose, or often, to better advantage, in half-grain doses, repeated every two hours till purgation occurs. For diarrhea or vomiting in dogs, calomel is useful in removing the source of irritation, in being antiseptic and easily borne by an irritable stomach. In accordance with the theory that calomel is transformed by the alkaline intestinal secretions into the grey mercurous oxide it has been the custom to combine sodium bicarbonate with it in order to facilitate this transformation. Sufficient evidence to substantiate the occurrence of the transformation is wanting and the clinical value of the combination is doubtful. The administration of calomel should be followed by oil, salines or other cathartics, if purgation does not occur within twenty-four hours after its ingestion, otherwise mercurialism may occur.

In jaundice, with light-colored feces, gastro-duodenitis or constipation, calomel is a valuable remedy for dogs. In the jaundice occurring as a form of influenza in horses, nitro-muriatic acid is more effective. Calomel is one of the best remedies for the treatment of dysentery unless there is great weakness. It should be

continued in repeated small doses till the character of the discharge changes. Foals and calves, with indigestion and diarrhea, may be given calomel to advantage to remove the source of irritation in the digestive tract. Calomel must be combined with a small dose of aloes, or with linseed oil, to form an effective cathartic for the horse. As aloes acts on the large, and calomel on the small intestines, the above combination secures a general purgative influence.

Cattle are given calomel, followed by the administration of salines, to produce free catharsis. As a remedy for round worms, ¼ to ½ grain each of santonin and calomel, with 5 grains of sugar of milk, are administered to dogs four times, at half hour intervals, and followed by castor oil. Lumbricoid worms in the horse may be treated by conjoining 2 drachms of santonin with 1 drachm of calomel, given to the fasting animal, and followed by a pint of linseed oil. One dram each of calomel, extract of male fern and aloes with one half ounce of ginger make a good anthelmintic ball for the horse. Calomel was formerly very frequently used, and is occasionally prescribed to this day in the treatment of enteritis, pleuritis, meningitis, peritonitis, pericarditis, and iritis, for its antiphlogistic and alterative action in supposedly diminishing inflammatory exudations.

At the present time these actions are very much questioned, and any beneficial effects accruing from the use of calomel in inflammatory diseases are now ascribed to its action as a purgative and intestinal antiseptic in destroying and eliminating toxins from the bowels.

Calomel is of value in inflammatory diseases when given at the onset of the attack. In dropsy (ascites of dogs), calomel sometimes acts as a useful diuretic, when combined with digitalis and squill (gr.i. each) in pill form.

Administration.—Calomel is given to cattle on the tongue or in gruel; to horses in ball, on the food, or on the tongue, to dogs in pill, tablet or on the tongue; to fowl on the food (gr.i.). The compound cathartic pill is a good purgative preparation for occasional use. Two or three pills for large dogs; one to two pills for small animals.

HYDRARGYRI IODIDUM RUBRUM.

The red mercuric iodide is a favorite remedy in veterinary practice. It causes absorption of morbid exudations through its counter-irritant, local absorbent and alterative effect, in combining the action of iodine and mercury. It is employed with 8 to 10 or 12 parts of lard or vaseline, and is of value in the treatment of peri-

ostitis with osseous deposits, especially for splints. Spavin and ringbone are treated with red iodide of mercury alone, but are generally cured more effectively by rest, firing, and blistering. The red iodide of mercury ointment is also of use for enlarged glands, chronic swelling about tendons, joints or bursæ; and applied about the throat in chronic laryngitis and "roaring." The ointment is rubbed on splints every third day, or until vesication is produced, and the hair begins to drop out, when its use is stopped for a time. It is useful in chronic rheumatic joints and in induration of the udder in bovines. Like other mercury preparations, the red iodide must not be employed in large quantities over an extensive surface. It is much more irritant locally than blue ointment.

UNGUENTUM HYDRARGYRI NITRATIS.

Citrine ointment is similar to unguentum hydrargyri ammoniati (white precipitate ointment), but more powerful, and should be diluted with equal parts of lard. These preparations are used for their stimulant action in granular lids, chronic eczema, pityriasis, and for their anti-parasitic effect in ring-worm.

SECTION VII.

Arsenum.

Arsenic is not used in the metallic state as medicine.

ARSENI TRIOXIDUM. Arsenic Trioxide. (U. S. P.)

ACIDUM ARSENOSUM. Arsenous Acid. As_2O_3. (U. S. P., 1890.)

Synonym.—Acidum arseniosum, B. P.; acidum arsenicosum, P. G.; arsenic trioxide, white arsenic, arsenicum album, arsenic, arsenious anhyrid, E.; acid arsenieux, arsenic blanc, fleurs d'arsenic, Fr.; arsenicsäure, weisser arsenic, G.

Derivation.—Arsenical ores are roasted and purified by sublimation.

Properties.—A heavy solid, occurring either as an opaque, white powder, or in irregular masses of two varieties; the one

amorphous, transparent and colorless, like glass; the other crystalline, opaque, or white, resembling porcelain. Both are odorless and tasteless. The glassy variety dissolves slowly in 30 parts of water; the porcelain-like in 80 parts of water. Arsenous acid is sparingly soluble in alcohol, but soluble in glycerin, hydrochloric acid and solutions of the alkali hydrates and carbonates. When heated to 424° F., arsenous acid is completely volatilized without melting.

Incompatibles.—Lime water, salts of iron and magnesia.

Dose.—H., gr.i.-v. (.06-.3); Sh. & Sw., gr.i.-ii. (.06-.12); D., gr. $\frac{1}{30}$-$\frac{1}{10}$ (.002-.006).

Usual dose for H., gr.ii.-iii. (.12-.2).

Liquor Potasii Arsenitis. Solution of Potassium Arsenite. (U. S. P.)

(*Fowler's Solution.*)

Synonym.—Liquor arsenicalis, B. P.; liquor kali arsenicosi, P. G.; solutio arsenicalis Fowleri, kali arsenicosum solutum, arsenical solution, E.; liqueur arsenicale de Fowler, Fr.; Fowlers'-che tropfen, G. Arsenous acid, 10 Gm.; potassium bicarbonate, 20 gm.; compound tincture of lavender, 30 Cc.; distilled water to make 1000 Cc. Strength, 1 part of arsenous acid in 100.

Dose.—H. & C., ʒ ii.-ʒ i. (8.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., ♏ii.-x. (.12-.6).

Usual dose for H., ʒ ss. (15.).

Liquor Acidi Arsenosi. Solution of Arsenous Acid. (U. S. P.)

Synonym.—Liquor arsenici hydrochloricus, B. P.; hydrochloric solution of arsenic, E.; liqueur arsenicale hydrochlorique, Fr.; chlorarsenik-lösung, G.

Arsenous acid, 10 Gm.; diluted hydrochloric acid, 50 Cc.; distilled water, a sufficient quantity to make 1000 Cc. Strength, 1 part of arsenous acid in 100.

Dose.—Same as Fowler's solution.

Atoxyl. Sodium Arsanilate (C_6H_7 NAs O_3 Na + 3 H_2O).

A combination of anilin and arsenic, a white, soluble, crystalline powder containing 26 per cent. of metal arsenic. Hare states that atoxyl is $\frac{1}{40}$ as toxic as Fowler's solution. Atoxyl is given subcutane-

ously in ten per cent. freshly prepared solution in trypanosomiases (dourine, surra, nagana), piroplasmes, anemias and leukemia.

Dose.—Gr. iv., gradually increased to gr. xv., once daily. Overdosage has caused blindness.

A reduction-product of atoxyl, arseno-phenyl-glycin, a yellow, soluble powder, bids fair to supersede atoxyl in trypanosomiases, as it cures apparently by one injection. It is too recent to judge its true value as yet.

Sodium cacodylate is a white soluble powder identical in action with arsenic.

Dose.—H., gr. x.-xl.; D., gr. ¼-½ subcutaneously.

It has been used successfully in the treatment of dourine, and other trypanosomiases, given in the dose of 8 grs. twice daily under the skin to horses for 5 days, followed by an intermission of a week and the same repeated.

ACTION OF ARSENICAL COMPOUNDS.

External.—Arsenous acid acts as a caustic on raw surfaces and mucous membranes. It produces considerable pain, and may lead to poisoning. In frogs poisoned by arsenic the epidermis peels off very rapidly, owing to degeneration of its lower layers.

Internal.—Digestive Tract.—Arsenic, when given in minute doses, improves the appetite, and increases both the motion and secretions of the stomach and duodenum. In larger amounts, arsenic is an irritant, causing loss of appetite, nausea and digestive disturbance. In toxic doses arsenic produces gastro-enteritis.

Blood.—Arsenic is absorbed into the blood, and in some forms of anemia increases notably the number of red corpuscles, and to some extent the hemoglobin.

Circulation.—It is said that arsenic stimulates the pulse rate when given in minute doses. In large doses it has a local depressing action on the heart—and probably on the vasomotor centre—lowering the force and frequency of the heart and reducing blood pressure. The nerve endings, ganglia, and muscle of the heart are alike paralyzed, and this action takes place when the heart is removed from the body.

Respiration.—In small doses arsenic quickens the breathing and stimulates the respiratory centre; whereas in lethal amounts the respiration fails through lowered blood pressure and exhaustion.

Nervous System.—The nervous apparatus is powerfully influenced by arsenic. Toxic doses cause paralysis of the spinal tracts, in frogs, with loss of sensation, motion, and reflex action, and the

brain and nerves are also depressed. The nerve trunks are chiefly affected in the higher animals. There is peripheral neuritis and trophic changes occur. Medicinal doses of arsenic are stimulant to the nervous system generally.

Metabolism.—Therapeutic doses probably diminish tissue change and the elimination of urea and carbonic dioxide. Large doses, on the other hand, increase metabolic processes and the escape of nitrogenous waste.

Elimination.—Arsenic is eliminated slowly by most channels, but mainly by the urine and to a less extent by the mucous membrane of the respiratory and digestive tracts. Traces are found in the milk, sweat, tears and saliva. It exists in, and can be recovered from, the bodies of animals years after their death from toxic amounts of arsenic.

Summary.—Arsenic is unfortunately one of the drugs whose physiological action—so far as we know it—does not throw any light, in many instances, upon its therapeutic effects. In altering the condition of the patient for the better, in some diseases, it is described by that vague and otherwise indefinable term, "alterative."

Toxicology.—The lower animals, as the horse and cow, are proportionately not nearly so susceptible to the poisonous effects of arsenic as the human subject; 1½ grains is the smallest fatal dose reported in man. An amount as large as one drachm of arsenous acid in solution is required to cause death in a horse or cow, although much smaller quantities have produced death when repeated a number of times (two daily doses of 45 gr., four daily doses of 30 gr. have proved fatal to horses). One half ounce to an ounce and a half of white arsenic is the toxic single dose for the horse and cow, and from one to two drams for sheep—with considerable variations. Dogs have been killed by 3 grains. Mild toxic action is seen following therapeutic doses of arsenic when the physiological limit is reached. This condition is characterized by loss of appetite (nausea and vomiting in dogs), watery discharge from the nose and eyes, puffiness of the eyelids, indigestion with mild colic, and diarrhea. The pulse may be accelerated and harder than normal. The appearance of albumin in the urine is the surest sign that arsenic has been pushed past the safe physiological limit.

Acute Poisoning begins with bilious, mucous, or bloody purging and colic. There is vomiting in dogs. Thirst is excessive; the urine is high-colored and albuminous; the pulse is feeble, small and frequent; the respiration is rapid and difficult from abdominal pain; the extremities are cold, and there is great weakness of the limbs. Collapse, with convulsions and coma, often close the scene in from five to twenty hours to three days.

A sub-acute form of poisoning occasionally occurs after a remission from the acute attack, only to be followed by death in from two to five days. In the interim, cutaneous eruptions may appear. Rarely, death takes place within an hour or two, in coma, collapse or convulsions.

Chronic Poisoning, such as is seen in the human subject living in apartments furnished with arsenical wall paper or fabrics, or in those working in arsenic, is rarely observed in animals and only occurs in those living in the immediate vicinity of smelters and chemical works. In this condition there are symptoms similar to those noted above as occurring in the milder form of arsenic poisoning, together with gradual loss of strength and flesh, suppression of milk, nasal ulcers, local paralysis or paraplegia, and anesthesia. A slightly raised, dark red or purplish band ⅛ to 3/16 in. wide is often seen on the gums at the base of the upper and lower incisor teeth of horses, the hair grows unusually long, the breath has a garlicy odor and there are salivation, drooling and cough, loss of appetite, and constipation with mucus coated feces, followed by diarrhea (Salmon). Fatty degeneration of the liver, kidneys, heart, stomach and muscles, in cases of chronic arsenical poisoning, is found after death.

The *post-mortem* changes observed after acute poisoning are as follows: The gastric mucous membrane, especially the villous portion in horses, is swollen, softened and covered with patches of a deep crimson or dark brown color. There is rarely ulceration. The upper portion of the small intestines, and in horses sometimes the whole of the intestinal tract, is similarly affected with that of the stomach. There is generally a wide-spread fatty degeneration of the stomach, bowels, internal organs and muscles. Congestion of the trachea and lungs and hemorrhages into the latter are often present.

The treatment of acute poisoning depends mainly upon the use of the official freshly prepared arsenic antidote (ferri oxidum hydratum cum magnesia) in large quantities. If this can not be obtained, an antidote can be prepared by precipitating Monsel's Solution, or the tincture of the chloride of iron, with sodium bicarbonate or ammonia. Dialyzed iron may be precipitated with an alkali. In either case the precipitate should be washed in a filter of muslin and given in large amounts. If vomiting has not occurred, zinc sulphate should be given dogs and cats, or the stomach tube resorted to, and the stomach well washed out. The after treatment is carried out with castor oil, demulcents, opium and external heat. Sweet spirit of nitre is to be prescribed, with considerable water, to flush out the kidneys.

Uses External.—A paste containing 1 part each of arsenous

acid and gum arabic, with 5 parts of water, is used to destroy warts and morbid growths. Arsenous acid, diluted with 5 parts of lard, may be employed to slough out fistulous tracts. In any case, there is danger of poisoning through absorption, if a sufficient amount of arsenic is used; but, on the other hand, the danger is slight if a large enough quantity is applied to cause rapid sloughing. Arsenic has been the principal constituent of so-called "sheep-dips" employed to kill ticks and other parasites in the wool. Finlay Dun recommends 2½ lbs. of arsenous acid with an equal amount of pearl ash, soft soap, and sulphur, dissolved in 10 gallons of boiling water and added to 90 gallons of cold water. This quantity will suffice for dipping 100 sheep. The sheep are submerged, except their heads, for a few seconds, and placed on a grating to drain into a tub, from which the water flows back into the first receptacle. The excess of water in their fleeces is squeezed out with the hands and a scraper. Sheep and other animals have been poisoned after dipping, by eating grass and fodder on which they have drained; therefore the sheep should always be kept on clean floors or yards in the open air and sunlight until they have become thoroughly dry. The lime and sulphur dip recommended by the U. S. Agric. Dep't, or the tobacco and sulphur dip, to be found under Scab (p. 739), are as effective and safer. Arsenic and tar solution is most efficient for destroying ticks and preventing Texas fever in cattle (see p. 710).

Uses Internal.—Arsenic is of the greatest service in the treatment of indigestion in horses associated with malnutrition and staring coat. In this condition, arsenous acid is often combined with sodium bicarbonate and nux vomica, and may be given in powder on the food. It is also of value in atonic diarrhea, and is used in both the serous and dysenteric varieties. In diminishing tissue change, and in acting as a blood tonic, arsenic is believed to improve the condition, endurance, and wind in horses, and is popularly prescribed by dealers and others.

The classical case of the arsenic-eating peasants of Styria seems to corroborate this view. These people appear to be very robust and healthy. Five grains of arsenic was given experimentally to one of them without producing any untoward effect. Arsenic seems to influence favorably diseased mucous membranes of the respiratory tract, to improve their nutrition, and hasten absorption and repair in diseases of the air passages. Coryza, ozena, chronic cough, asthma, emphysema and "broken wind" are greatly benefited by a course of arsenic, and in chronic conditions the treatment should be sustained for months in small doses.

"Thick wind" and convalescence from acute bronchitis, pneumonia or influenza are favorably influenced by arsenic. Arsenic is

one of the best agents we can prescribe in general debility and anemia and may be conjoined with bitters or iron.

Arsenic is indeed the next best remedy to iron in anemia, and, in pernicious anemia and leukemia, it is the remedy offering the greatest chances of improvement, when given in gradually increasing doses until horses are taking as much as one ounce of Fowler's Solution twice daily; and dogs one-half a dram.

In dry, scaly skin diseases, arsenic is the most successful internal remedy, but should not be prescribed in moist conditions associated with a proliferation of new cells, or exudate of serum or other liquid. It is particularly useful in chronic squamous, or papular eczema, acne and chronic urticaria, when given for a considerable length of time in small doses.

In the human subject, arsenic is almost a specific in chorea, but does not seem to yield such good results in that disease in dogs, usually associated with distemper. Fowler's Solution should be given to dogs with chorea, in doses of two or three drops three times daily, and gradually increased till the physiological limit is reached. The same treatment should be tried in diabetes mellitus in dogs. Large single doses of arsenous acid (3 ss.) are sometimes given with calomel (3i.) and aloes (3iv.), in a ball to horses to kill round worms.

Administration.—Arsenic is given to horses as Fowler's Solution, or arsenous acid, on the food. If continued for a long time, arsenic must be prescribed in small doses once daily, or in larger doses once in two or three days. Arsenic is exhibited to dogs in tablet or pill, and as Fowler's Solution. The administration of Fowler's Solution secures more rapid and accurate results than that of white arsenic.

Antimonium.

(*The metal antimony is not used in medicine.*)

Antimonii et Potassii Tartras. Antimony and Potassium Tartrate. $2\,K\,(SbO)\,C_4H_4O_6 + H_2O$. (U. S. P.)

Synonym.—Antimonium tartaratum, B.P.; tartar emetic, tartarated antimony, tartarus emeticus, stibio-kali tartaricum, E.; antimonii potassio-tartras, antimonium tartarizatum, tartarus stibiatus, P. G.; tartrate de potasse et d'antimoine émétique, tartre stibié, Fr.; brechweinstein, G.

Derivation.—Make a paste with cream of tartar, antimony

trioxide and water. Set aside 24 hours, boil in water 15 minutes and crystallize. $2\ K\ HC_4H_4O_6 + Sb_2O_3 = 2\ K\ (SbO)\ C_4H_4O_6 + H_2O$.

Properties.—Colorless, transparent crystals of the rhombic system, becoming opaque and white on exposure to the air; or a white, granular powder, without odor, and having a sweet, afterwards disagreeable, metallic taste. Soluble in 15.5 parts of water; insoluble in alcohol.

Dose.—H. & C., 3 ii.-iv. (8.-15.); emetic, pigs, gr.iv.-x. (.24-.6). D., $\frac{1}{10}$-$\frac{1}{2}$ (.006-.03); emetic, D., gr.i.-ii. (.06-.12).

PREPARATIONS.

Vinum Antimonii. Wine of Antimony. (U. S. P.)

Synonym.—Vinum antimoniale, B. P.

Antimony and potassium tartrate, 4 Gm.; boiling distilled water, 65 Cc.; alcohol, 175 Cc.; white wine to make 1000 Cc. (U. S. P.)

Dose for Dogs.—ɱv.-3i. (.3-4.).

Syrupus Scillæ Compositus. Compound Syrup of Squill. (U. S. P.)

Synonym.—Hive syrup. Fluidextract of squill, 80 Cc.; fluidextract of senega, 80 Cc.; antimony and potassium tartrate, 2 Gm.; purified talc, 20 Gm.; sugar, 750 Gm.; water to make 1000Cc.

Dose for Dog.—ɱv.-xxx. (.3-2.)

ACTION OF ANTIMONII ET POTASSII TARTRAS.

Tartar emetic is the only antimony compound suitable for internal use. The sulphide and oxide of antimony are insoluble, save in the hydrochloric acid of the gastric juice, and are not so certain or reliable in their action as tartar emetic. Kermes mineral and golden sulphur, containing variable amounts of antimony trisulphide and trioxide, are even more uncertain and unreliable than antimony sulphide or oxide.

External.—Tartar emetic is irritant, and when rubbed into the skin produces a pustular eruption and often sloughing and destruction of tissue.

Internal.—Stomach and Bowels.—Tartar emetic is a gastro-intestinal irritant, causing salivation and nausea in small doses, vomiting and diarrhea in large quantities; while toxic amounts are followed by vomiting (in carnivora), serous or bloody purging, great depression of the circulation and respiration, muscular weakness, collapse and death.

Uneasiness, nausea, colic and death have been reported in horses only after enormous doses of tartar emetic by the mouth. The horse and ruminants are comparatively insusceptible to the action of tartar emetic. The writer has observed a cow, however, in which nausea and actual vomition occurred, following a therapeutic dose of kermes mineral in electuary.

Tartar emetic is a powerful but slowly acting emetic (attended with a good deal of nausea) in dogs. Tartar emetic has been recovered in the first vomitus following its intravenous injection. It also expels the contents of a bladder artificially replacing the normal stomach. These results go to show that tartar emetic acts both as a specific emetic upon the vomiting centre, and locally as a specific irritant and an emetic upon the mucous membrane of the stomach. Tartar emetic is eliminated in great part by the mucous membrane of the alimentary canal.

Circulation.—The principal action of antimony is exerted upon the heart and vessels. The heart muscle is weakened and vascular tension markedly lowered by large doses of tartar emetic. This action depends upon the influence of antimony on the cardiac muscle itself, and possibly upon the vagus nerve-endings in the heart. Vascular tension is lowered through depression of the heart and of the peripheral vasomotor nerves or muscle of the vessel walls. Whether the vasomotor centre is also depressed is uncertain. The pulse is reduced in force and frequency by large doses of tartar emetic. Following lethal amounts, the heart becomes flabby and relaxed, and death occurs in diastolic arrest. The preceding remarks apply only to the action of tartar emetic upon carnivora.

Antimony was formerly a very popular drug when general depressant and depletant treatment was in vogue, because of its powerfully depressing action upon the circulation.

Respiratory Organs.—Small doses of antimony increase secretion of bronchial mucus. Toxic amounts weaken the respiratory movement by lowering the functional activity of the respiratory and vagus centres, and causes a copious outpouring of serous and mucous secretion into the bronchial tubes, which has the effect of drowning an animal in its own secretions. This action is only seen in horses after intravenous injection of toxic quantities of tartar emetic. The respiration is slow and labored in poisoning.

Nervous System.—Large doses of antimony depress the functional activity of the brain and sensory tract of the spinal cord. Larger doses produce loss of reflex action and anesthesia, owing to the influence of antimony upon the sensory side of the cord; while in toxic amounts, antimony is a general paralyzant to all the spinal centres and to the motor nerves.

Muscles.—In carnivora and man, antimony lessens muscular strength and relaxes spasm through its depressing action upon the motor nerves and muscular tissue.

Elimination.—Antimony is mainly eliminated by the mucous membrane of the stomach and bowels, but also by the kidneys, bronchial mucous membrane, and other channels.

Toxicology.—The symptoms are those described under "Action on the Stomach and Bowels." The fecal discharges in man are copious and of the rice water appearance characteristic of Asiatic cholera. If vomiting is not free, zinc sulphate should be given, or the stomach washed out. Tannic acid should be administered as a chemical antidote, together with the use of external heat, alcohol, digitalone, strychnine and morphine subcutaneously, and demulcents by the mouth.

Uses External.—Tartar emetic is used in ointment, in the strength of 1-4, over chronically enlarged and rheumatic joints of cattle. It is also employed over the sides of the chest in cattle, to produce counter-irritation and pustulation in the strength of 1 part to 12 of lard.

Internal.—The therapeutic value of tartar emetic is limited mainly to canine practice. Antimony is still prescribed largely by the Germans as a general and circulatory depressant and expectorant for horses. General depressant treatment has gone out of vogue and is not usually indicated in inflammatory affections, and even if it were, antimony does not exert such an action in any considerable degree upon horses or ruminants.

Aconite is a much more valuable and efficient circulatory depressant than antimony for the horse. There are three indications for antimony in canine practice: 1st, as an emetic; 2nd, as a general depressant in inflammatory diseases and in strong patients; 3rd, as an expectorant in acute bronchitis. The first indication is generally attained more promptly and safely by zinc sulphate. The second and third indications may be combined by prescribing antimony in the first, or dry stage of acute bronchitis in dogs, in the form of hive syrup. For example:

℞.
Syr. Scillæ Co.
Sp't's Æther. Nitrosi.....āā ʒ ss.
M. Liq. Ammon. Acetatis.....ad ʒ iv.
S. Teaspoonful every 2 hours.

Antimony may be employed as an emetic in bronchitis to clear the stomach and upper part of the respiratory tract of secretions,

and to reduce the force and frequency of the heart. Ipecac is, however, a better and safer agent for this purpose, and antimony is generally counter-indicated in the second, or exudative stage of bronchitis.

The Germans prescribe tartar emetic very commonly to horses as a parasiticide against round worms and tape worms. Four or five drachms are given in aqueous solution to the fasting animal, and followed by the administration of a dose of oil.

SECTION VIII.

Phosphorus

PHOSPHORUS. Phosphorus. P. (U. S. & B. P.)

Derivation.—Digest bones in sulphuric acid, or treat bone ash with sulphuric acid; filter and evaporate. $Ca_3 (PO_4)_2$ (bone ash) $+ 2\ H_2SO_4 = Ca\ H_4\ (PO_4)_2$ (acid calcium phosphate) $+ 2\ Ca\ So_4$.

Heat acid calcium phosphate, charcoal, and sand together, and distil over phosphorus into water.

Heat breaks up $Ca\ H_4\ (PO_4)_2$ into $Ca\ (Po_3)_2$ (calcium metaphosphate) $+ 2\ H_2O$.

Then: $2\ Ca\ (PO_3)_2 + 2\ SiO_2 + 10\ C = P_4 + 2\ Ca\ Si\ O_3 + 10\ C\ O$.

Properties.—A translucent, nearly colorless solid, of a waxy lustre, having at ordinary temperature about the consistency of bees' wax. By long keeping, the surface becomes red and occasionally black. It has a distinctive but disagreeable odor and taste. It should not be tasted except in a state of great dilution. When exposed to the air it emits white fumes which are luminous in the dark, and have an odor somewhat resembling garlic. On long exposure to the air, it takes fire spontaneously. Insoluble in water, or nearly so; soluble in 350 parts of alcohol, in 80 parts of ether, in about 50 parts of any fatty oil, and very soluble in chloroform and carbon disulphide. Besides the official form there are several other allotropic forms of phosphorus, including the red, or amorphous, the black, and the crystallized metallic phosphorus.

Red phosphorus is non-poisonous, owing to its insolubility preventing its absorption in the digestive tract.

Dose.—H., gr.i.-ii. (.06-.12); C., gr.ii.-iii. (.12-.18); Sh. & Sw., gr. 1/100-1/20 (.0006-.003); D., gr. 1/100-1/20 (.0006-.003).

PREPARATIONS.

Oleum Phosphoratum. Phosphorated Oil. (B. P.).

Phosphorus, 1 gm.; expressed oil of almond and ether, of each a sufficient quantity to make 100 gm. (U. S. P. 1890.)

Properties.—A clear, yellowish liquid, having the odor of phosphorus and ether. The ether in this preparation evaporates in time and the strength is proportionately, and perhaps dangerously, increased.

Dose.—H., 3 ii.-iii. (8.-12.); D., ♏i.-v. (.06-.3).

Pilulae Phosphori. (U. S. P.)
Each pill contains gr. 1/100 of phosphorus.

Pilula Phosphori. (B. P.)
2 per cent. phosphorus.

Dose.—D., pills, i.-ii.

ACTION OF PHOSPHORUS.

Internal.—The sole physiological action of phosphorus which would suggest, and in some manner explain, its therapeutic use is that on bones. Phosphorus, when given in small doses to growing animals, apparently stimulates the bone-making cells (osteoblasts) and the growth of denser bone, both from cartilage and periosteum. In older animals the lamellæ of spongy tissue are made thicker and, in fowl, the narrow cavity may be wholly obliterated by the deposition of hard bone through the ingestion of phosphorus. If calcium salts be withheld from the food the activity of the osteoblasts continues but the new bone is soft and of the nature of bones in rickets. The precise mode of action of phosphorus on normal and diseased bones (rickets and osteomalacia) has yet to be determined.

There appears to be clinical evidence that phosphorus is a nerve stimulant and, in man, it is said that large doses cause mental exhilaration, increased capacity for work and excite sexual desire. Experiments with phosphorus on animals show no special action of the drug on the nervous system. Phosphorus is absorbed largely in an unchanged condition in solution in fatty matter in the bowels bowels and blood into phosphureted hydrogen (PH_3) and further and as vapor. Some of the phosphorus is probably converted in the oxidized into phosphoric acid in the body. Its fate is unknown, but

some phosphorus is eliminated as vapor from the lungs and some in organic compounds in the urine.

The toxic action of phosphorus differs decidedly from its therapeutic effect and so does the action of pure phosphorus from its compounds. The action of phosphates, phosphoric acid and hypophosphites is not at all that of phosphorus.

Most of the hypophosphites are eliminated unchanged in the urine and do not act as phosphates, as formerly believed. They appear to have little more influence than sodium chloride, except the iron salt, where the metallic ion acts as other iron compounds. Phosphoric acid stimulates digestion and *secretin* formation, like other mineral acids, but is inferior in this respect to hydrochloric acid. It has been given internally for its supposed action as a phosphate, but the organic phosphate compounds of the body cannot be built from the inorganic salts.

Calcium hypophosphate, lactophosphate and glycerophosphate act similarly to calcium phosphate (page 150).

Toxicology.—The symptoms of poisoning do not ordinarily appear until some hours after ingestion of toxic doses (15 to 20 grains of phosphorus poison horses; 1½ to 4 grains are toxic for dogs). Then abdominal pain, nausea and vomiting (in those animals in which it is possible) and purging occur. The breath, vomitus and fecal discharges may be luminous, and have the odor of phosphorus. There is fever, anorexia and thirst. This condition is followed by an intermission in which the patient appears to be recovering, only to be succeeded by jaundice, hemorrhages (due to fatty degeneration of vessels and blood poor in fibrinogen), nervous symptoms, as delirium, coma and convulsions, and death. The urine rarely becomes albuminous in animals, but contains leucin and tyrosin. The heart muscle is directly paralyzed by lethal doses.

Grave, destructive metabolic changes (autolysis) occur in the tissues—especially the liver. There is general fatty degeneration of the viscera and muscles. The blood is disorganized, and there are widespread ecchymoses. Jaundice follows closure of the common, or hepatic duct, or smaller biliary tubules (owing to proliferation of interstitial tissue, seen also in the stomach and kidney), and disorganization of the blood. There is rapid atrophy of the liver, and phosphorus poisoning in man is often indistinguishable during life from acute yellow atrophy of the liver. Nitrogenous elimination is increased. Imperfectly decomposed products of metabolism, as leucin and tyrosin, occur in the urine; also an excess of urea and ammonia and often blood, bile and fat and sarcolactic acid. It is a matter of dispute whether the fat deposited in the cells of the tissue is formed there (fatty degeneration), or is conveyed thence

from that already existing in the subcutaneous tissue. Chronic poisoning, attended with necrosis of the jaw and other symptoms, and occurring among workers in phosphorus, is unlikely to occur in the lower animals. Acute poisoning is treated by emptying the stomach with a stomach tube or copper sulphate; the latter forming an insoluble phosphide of copper. Cathartics should also be administered. Permanganate of potash (H., 3 ii in 2 qts. of water; D., gr.xv. in Oss. water) or hydrogen dioxide should be employed as antidotes, for their oxidizing action. Old turpentine is usually recommended as the antidote, but only the French variety is of any value, and that is generally unobtainable. Demulcents and opium are in order after evacuant and antidotal treatment has been carried out, but oil should never be given in phosphorus poisoning, as it assists the solution and absorption of the poison.

Uses.—Phosphorus is indicated as a stimulant to the growth of bone in rachitis, after fractures, and in osteomalacia; as a nerve stimulant and tonic in conditions of nervous exhaustion and impaired vitality, due to excessive activity of the sexual organs or otherwise. It is used empirically in treatment of boils, acne, and scaly eczema, epilepsy, chorea and paralysis, and has been prescribed with alleged advantage as a general stimulant in pneumonia.

Administration.—Phosphorus may be given in pill or ball, with cacao butter, or in the official preparations to dogs, and in a saturated alcoholic solution to horses. Phosphide of zinc represents the action of phosphorus, and yields phosphureted hydrogen in its decomposition in the body. It may be given to dogs (gr.1-10) in the form of pills.

SECTION IX.

Chlorine.

Chlorum. Chlorine. Cl.

(*The gas is not official.*)

Liquor Chlori Compositus. Compound Solution of Chlorine, Chlorine Water. (U. S. P.)

Synonym.—Aqua chlori, chlorum solutum, aqua oxymuriatica, solution of chlorine, E.; aqua chlorata, P. G.; eau chlorée, chlore liquide, Fr.; chlor-wasser, G.

An aqueous solution of chlorine (Cl), containing about 0.4 per cent. of the gas.

Derivation.—Generate chlorine gas with hydrochloric acid, 18; potassium chlorate, 5; and water to make 1000. Heat in flask.

Properties.—A clear, greenish-yellow liquid, having the suffocating odor and disagreeable taste of chlorine, and leaving no residue on evaporation. Incompatible with salts of silver and lead. The preparation deteriorates on keeping.

Dose.—Not used internally.

Calx Chlorinata. Chlorinated Lime. $Ca\,Cl_2\,O_2$, $Ca\,Cl_2$. (U. S. & B. P.)

Synonym. Calx chlorata; calcaria chlorata, P. G.; chloris calcicus, chloruretum calcis, calcii hypochloris, chloride of lime, hypochloride of calcium, bleaching powder or bleach, E.; chlorure de chaux, poudre de Tennant, ou de Knox, Fr.; chlorkalk, bleichkalk, G.

A preparation often improperly called "chloride of lime." It should contain not less than 30 per cent. of available chlorine.

Derivation.—Pass chlorine gas over calcium hydrate, when chlorinated lime, a mixture of calcium chloride and hypochlorite results: $2\,Ca\,O_2H_2 + 2\,Cl_2 = Ca\,Cl_2\,O_2, Ca\,Cl_2 + 2\,H_2O$. It may also be regarded as a mixture of lime and chlorine: $2\,Ca\,O_2H_2 + 2\,Cl_2 = 2\,Ca\,O, 2\,Cl_2 + 2\,H_2O$.

Properties.—A white, or grayish-white granular powder, exhaling the odor of hypochlorous acid, having a repulsive saline taste, and becoming moist and gradually decomposing on exposure to air. In water or in alcohol it is only partially soluble. It evolves chlorine on exposure to the air or on addition of an acid. Chlorinated lime possesses an alkaline reaction and bleaching properties.

Dose.—Only of value externally.

PREPARATION.

Liquor Calcis Chlorinatæ. Solution of Chlorinated Lime. (B. P.)

This solution should yield about 3 per cent. of chlorine.

Liquor Sodæ Chlorinatæ. Solution of Chlorinated Soda. (U. S. & B. P.)

Synonym.—Liquor sodæ chloratæ, Labarraque's solution, E.

An aqueous solution of several chlorine compounds of sodium, containing at least 2.4 per cent., by weight, of available chlorine.

Derivation.—Monohydrated sodium carbonate, 65; chlorinated lime, 90; water to make 1,000.

Properties.—A clear, pale, greenish liquid, having a faint odor of chlorine and a disagreeably alkaline taste.

Dose.—Only of value externally.

ACTION AND USES OF CHLORINE.

Chlorine gas, in the presence of organic matter and moisture, unites with the hydrogen of water and sets free nascent oxygen. When chlorine comes in contact with sulphureted hydrogen, it removes and destroys the compound. Chlorine is thus a powerful oxidizing disinfectant agent and deodorizer. One-quarter of 1 per cent. of chlorine in solution is an effective germicide. When chlorine gas is inhaled undiluted, it is an irritant to the respiratory tract, producing sometimes spasm of the glottis, or severe bronchitis, and at other times a condition of narcotism, with death from paralysis of the respiratory center. In contact with living tissues, chlorine replaces the hydrogen of proteid compounds and forms hydrochloric acid with the hydrogen thus set free. The symptoms of poisoning are explained by the local irritation of the hydrochloric acid thus formed. In dilute form it is stimulant, antiseptic, and deodorant in relation to the body. Chlorine gas may be generated from salt and black oxide of manganese, 1 part each; with commercial sulphuric acid and water, 2 parts each.

The spores of most bacteria are killed after three hours' exposure to a moist atmosphere containing 0.3 per cent. of chlorine gas. Chlorine may be used to advantage in this manner as a substitute for sulphur fumigation. Chlorine water is employed, well diluted, for the same purposes and with the same results as the solution of chlorinated soda. Chlorinated lime varies much in strength. To be of any value it should be so irritating to the eyes that it cannot be held near the face. It owes its medicinal value to the hypochlorite of lime which it contains. If the compound is very moist, it is because calcium chloride preponderates. Chlorinated lime is often employed as a deodorizer, standing about premises in vessels, but is of no practical value unless it comes directly in contact with bacteria or sulphureted compounds which it is desirable to destroy. It is the best and cheapest germ destroyer we possess for disinfecting premises and other appurtenances, apart from the body, as walls and floors of buildings, fecal and other discharges,

sewers, privies and cesspools. A 10 per cent. solution is to be employed on the floors, walls and other parts of buildings. The pure compound may be mixed with manure and discharges. Chlorinated lime has the disadvantages of destroying the fertilizing value of manure, however, and of keeping floors constantly wet through its deliquescent properties. Even a 1 per cent. solution is germicidal, and may be employed to wash blankets, harness and other paraphernalia. It is said not to harm woolen or cotton fabrics, in the latter solution. Chlorinated lime is a useful disinfectant in privy vaults when the contents are kept continually covered with chlorinated lime.

One half ounce will sterilize and deodorize 50 galls. of polluted and bad smelling water, allowing a few hours for precipitation before use. The water supply of over 200 American cities is sterilized by "bleach." Upon the body, a 2 or 3 per cent. solution of chlorinated lime is employed as a stimulant, deodorant, and antiseptic for decubitus, foul-smelling and gangrenous sores, severe burns and indolent ulcers. It is used in 10 per cent. solution as a parasiticide in ringworm and scabies. A 1 per cent. solution forms a valuable wash in ulcerative stomatitis. Chlorinated lime may be prescribed, with an equal amount of lard, upon ulcers when a stimulating action is desired. Chlorinated lime (gr.-xv. in ʒ ii. of water) is one of the most effective antidotes for snake bite, when injected in several places in the region of the lesion. Its internal administration is undesirable. The solution of chlorinated soda is a slight caustic, deodorizer and antiseptic preparation on indolent, sloughing, foul-smelling surfaces. It may be prescribed in sore throat, or ozœna, as a spray, or injected into the uterus, vagina or rectum. It is commonly diluted with 8 to 10 parts of water.

Bromine.

Bromum. Bromine. Br.

Derivation.—From seaweed and mineral springs.

Properties.—Heavy, dark, brownish-red liquid, volatilizing with the production of an irritating vapor. Soluble in 30 parts of water, and readily soluble in alcohol and ether. Of no value in veterinary medicine.

Potassii Bromidum. Potassium Bromide. K Br. (U. S. & B. P.)

Synonym.—Kalium bromatum, P.G.; bromkalium, G.

Derivation.—Obtained from liquor potassæ, bromine, and charcoal by the same process described in making potassium iodide (p. 229).

Properties.—Colorless, or white, cubical crystals, or granules; odorless, and having a pungent, saline taste. Permanent in the air. Soluble in about 1.5 parts of water and in 180 parts of alcohol.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., 3 ii.-iv. (8.-15.); D., gr. v.-ʒ i. (.3-4.).

*Sodii Bromidum. Sodium Bromide. Na Br. (U. S. & B. P.).

Synonym.—Bromure de sodium, Fr.; Bromnatrium, G.

Derivation.—Similar to potassium bromide. Liquor sodæ is used instead of liquor potassæ.

Properties.—Colorless, or white, cubical crystals, or a white, granular powder; odorless, and having a saline, slightly bitter taste. From air the salt attracts moisture without deliquescing. Soluble in 1.7 parts of water, and in 12.5 parts of alcohol.

Dose.—Same as potassium bromide.

ACTION OF THE BROMIDES.

External.—None.

Internal.—Digestive Tract.—The bromides, when ingested in concentrated form, may induce nausea and vomiting through irritation of the stomach produced by withdrawal of water from the gastric mucosa. This "salt action" is common to other salines. In a large, single dose, the bromides cause in horses muscular weakness, dulness and staggering gait, and slow respiration. The urine is increased in quantity and sexual desire diminished. Bromism may be produced in man, or the lower animals, by the continuous administration of the bromides. This condition is characterized by general weakness and unsteady gait, mental dulness, indigestion, fetid breath, cutaneous anesthesia, loss of sexual power, and occasionally an acneform eruption. Death has never been caused in man by the bromides.

* Ammonii bromidum, lithii bromidum, calcii bromidum and strontii bromidum are also official. These salts are given in the same doses as sodium bromide.

Nervous System.—The bromides are essentially depressant to nerve tissue. Therapeutically, this depressing action is seen particularly in relation to the motor centres of the middle region of the cerebral cortex; to the intellectual areas in the anterior cerebral region (in man); and to lessening reflex action. The whole nervous system is depressed, but the motor tract in the brain and the sensory nerves are the first to succumb to the influence of the bromides. Intellection is clouded, and dulness and mental apathy are observed in man after large amounts. Reflex action is diminished owing to interference with the passage of impulses from the sensory to motor cells of the cord and, later, to depression of the sensory nerves. Finally, with the continuous administration of large doses the motor area of the spinal cord, the motor nerves and muscles fall under the depressing action of these agents.

Circulation.—Potassium bromide is a powerful depressant to the heart in toxic doses. Medicinal doses injected into a vein induce weakness of the heart, but therapeutic amounts, given by the mouth, exert no appreciable effect upon the circulation. The depressing action of potassium bromide upon the heart is due wholly to the potassium ion; the bromine ion is not a heart depressant. There is practically no difference in the action of therapeutic doses of potassium, sodium, strontium, or ammonium bromides. Ischemia of the pia is seen under the influence of bromides. This is the result of depression of the cerebrum and sleep, and not the cause of sleep. The old idea that the beneficial action of the bromides, in relieving nervous excitability and in causing sleep, was due to the production of vasomotor spasm and cerebral amemia, is now exploded.

Temperature.—The temperature falls, following the action of toxic amounts of the bromides, owing to lessened muscular movements.

Sexual Organs. The bromides diminish sexual desire and power. In so doing they either depress the spinal centres or lessen peripheral sensibility of the genito-urinary tract.

Elimination.—The bromides are eliminated unchanged by all channels and are found in the sweat, urine, milk, saliva, intestinal secretions, etc. Elimination begins immediately but may not keep pace with continuous administration, and bromism may occur.

Uses Internal.—The bromides, being particularly useful in the treatment of functional nervous diseases, do not possess nearly the value in veterinary medicine that they have in human practice. Moreover, their use is limited mainly to canine disorders, as bromides have little influence upon diseases of horses.

Bromides are especially indicated in irritation of the motor

area of the cerebral cortex (convulsions), in general nervous excitability, in cerebritis, and in conditions due to exalted reflex action in dogs.

The bromides are indeed the best agents we can use to prevent convulsions in dogs. They should be combined with chloral and given, if necessary, per rectum. The bromides are useful in canine chorea, in connection with Fowler's Solution. With chloral the bromides are antidotes to strychnine poisoning. Sexual excitement in all animals may be allayed by the bromides. The bromides are occasionally of value in reflex cough, palpitation of the heart, and asthma, but are inferior to other agents in these disorders.

Potassium bromide is recommended in the treatment of tetanus of the horse, but opium, belladonna and cannabis indica are generally more effectual. If the bromides are used they should be given with chloral. Ammonium and sodium bromide are commonly said to be less depressant in large doses to the heart than the potassium salt, and strontium bromide less disturbing to the stomach in dogs. There does not appear to be sufficient scientific basis for either of these statements (see above).

Iodine.

IODUM. Iodine.

Synonym.—Iodinum, U. S. P. 1870; iodum, P. G.: iode. Fr.; jod., G.

Derivation.—Iodine is a non-metallic element (Hallogen) existing in combination in the animal, vegetable and mineral kingdoms. It occurs in seaweed, from which it is obtained by distillation. It is also mined in the form of iodates and iodides.

Properties.—Iodine occurs in heavy, bluish-black, dry and friable rhombic plates, having a metallic lustre, a distinctive odor, and sharp acid taste. It is soluble in 5,000 parts of water, and in 10 parts of alcohol; very soluble in ether and in solutions of potassium iodide. Iodine volatilizes on heating with the formation of a purple vapor. With starch, iodine forms an insoluble blue compound.

Dose.—H. & C., ℥ss.-i. (2.-4.); Sh. & Sw., gr.x.-xx. (.6-1.3). Not often used in solid state.

PREPARATIONS.

Liquor Iodi Compositus. **Compound Solution of Iodine. (Lugol's Solution.) (U. S. P.)**

Iodine, 5; potassium iodide, 10; water to make 100. (1-20).

Dose.—H. & C., 3 ii.-iv.(8.-15.); D., ℥ii-x.(.12-.6). Should be given in one quart of water to the larger animals.

Tinctura Iodi. (U. S. P.)

Iodine, 70; potassium iodide, 50; alcohol to make 1,000.

Dose.—H. & C., 3 ii.-iv. (8.-15.); D., ℥i.-v. (.06-.3).

Tinctura Iodi. (B. P.)

Dose.—Same as U. S. P. tincture.

Unguentum Iodi. 1-25. (U. S. & B. P.)

Too weak for most veterinary purposes.

Action External.—Iodine is one of the most effective and valuable of antiseptics for surgical purposes. The tincture will kill all pathogenic bacteria in vitro within one minute, whereas a 1 to 1000 solution of mercuric bichloride requires more than half an hour to destroy the same microörganisms. Moreover, the tincture has unusual penetrating power on the dry skin, finding its way into the hair follicles and cutaneous glands.

The tincture of iodine is perhaps the most efficient and popular disinfectant for use in sterilizing the skin for operations. But the skin must be dry or the sterilizing effect of the iodine is inhibited. Iodine must not be applied to the wetted skin because the wetting causes the epithelial cells to swell and thus prevents the iodine from penetrating into the sebaceous and sudoriparous glands, the very action upon which the special germicidal action depends. The tincture is also of much worth as an antiseptic on wounds (see p. 753). Iodine acts as a slow, moderate and prolonged irritant upon the skin and mucous membranes. The yellow stain produced by iodine may be removed by ammonia water, alkalies and sodium hyposulphite. A small amount of iodine is absorbed through the unbroken skin, and it is thought to have a special resolvent and alterative action over and above that of other counter irritants. Whether this be true or not, its easy mode of application makes it a very convenient counter-irritant for local uses.

Action Internal.—Iodine produces gastro-intestinal irritation and inflammation in large doses; and in toxic quantities induces colic, vomiting in animals capable of the act, and purging and salivation. The pulse becomes rapid and weak: there is often suppression of urine, and occasionally nephritis. Widespread fatty degeneration

has been found after fatal poisoning in the lower animals. If there is much starchy material in the bowels, the fecal discharges may be of a bluish color. Aphrodisiac action has been noted in man, following small doses of iodine. The treatment of acute poisoning is embraced in the use of starch by the mouth, or raw eggs, external heat; strychnine, digitalone, alcohol, and atropine subcutaneously. Chronic poisoning by iodine and iodides (iodism), in man, commonly causes symptoms analogous to a severe cold in the head, with pain over the frontal sinus, sore throat, running at the eyes and nose, gastric indigestion, together with an acneform, and occasionally purpuric or furuncular eruption.

These more frequent symptoms of iodism occur more often after the administration of potassium iodide than after that of iodine. The physiological action of the iodides is similar to that of iodine, which is transformed into iodides in the body. But the iodides are usually preferred for internal use since they are locally so much less irritating. Both iodine and potassium iodide are readily absorbed from mucous membranes, and are found in all the tissues and fluids of the body. Iodine is absorbed as iodides and, perhaps, in loose combination with albumin (iodoalbuminates)—and eliminated as iodides by all the usual channels, as well as by the mucous membranes. The kidneys eliminate the greater amount, but iodine is found in the saliva and gastric juice after it has ceased to be present in the urine. The effect of iodine on the thyroid gland probably accounts for much of its influence on the body. Iodine is essential for normal thyroid activity. Glandular hyperplasia (colloid goitre) is a physiological reaction to a deficiency of iodine. The iodine content of the gland varies inversely with the degree of enlargement. Giving iodine in simple goitre in puppies causes reduction of the glandular hyperplasia. An excess of iodine ingested in goitre will produce the same symptoms (hyperthyroidism) as occur in morbid conditions where an excess of thyroid secretion is formed (exophthalmic goitre in man), *i.e.*, rapid heart, tremors, wasting, excitement, etc.

Uses External.—Iodine is of most value applied externally, or locally. In sterilizing the skin for an emergency operation the hair should be clipped and shaved dry and the tincture of iodine applied without washing of the skin.

For other operations the skin may be scrubbed with soap and shaved and dried before applying the tincture. The tincture should always dry on the skin before the operation is begun. The routine method in human surgery for sterilizing the skin, accepted by leading surgeons, consists in first cleansing the skin with gasoline to remove the grease and then applying the tincture of iodine in full or half strength. Half strength should be used on mucous mem-

branes, as the vagina. Potassium iodide is administered internally because it is not irritating to the digestive organs. Although potassium iodide does not exactly represent the action of iodine, yet it is usually preferable for the reason just stated. Potassium iodide renders iodine soluble, and prevents its precipitation in fluids within and without the body; it is therefore combined with iodine, when concentrated solutions are desirable. Six parts of potassium iodide and twelve parts of iodine are added to one hundred parts of water, or ointment, to make a suitable counter-irritant preparation for the horse. A useful tincture for veterinary purposes contains 15 parts of iodine and 18 parts of potassium iodide in 100 parts of alcohol. Iodine is employed in aqueous and alcoholic solution, or in ointment, as above, either painted upon or rubbed into the skin over enlarged glands, rheumatic swellings about the joints or upon the chest in chronic pleuritis. It is also of value in strains, bruises, periosteal inflammation and muscular rheumatism. In the horse, severe sprains and inflammation of joints, bones, and periosteum, are treated more satisfactorily by blistering agents. Iodine is a valuable disinfectant and parasiticide, with equal parts of alcohol in alopecia areata, and particularly in ringworm and favus in dogs, when the tincture is applied locally. Iodine is applied externally, in the form of the tincture, on patches of chronic mange and eczema.

Iodine is often recommended for erysipelas, but is inferior to phenol for this purpose. In obstetric work the tincture of iodine should be applied to the cord after it has been ligated and trimmed, and reapplied every few days, to prevent septic infection with metastases in the joints. Iodine is injected into joints, synovial sacs, abscesses, and cavities of the body to promote healing through its antiseptic and irritant action; to cause adhesive inflammation, and in this manner to close cavities and to prevent the accumulation of fluids in them. The official tincture (℥ i.-ii.) is commonly used for injections.

The tincture of iodine may be injected undiluted directly into the substance of enlarged glands, in amounts varying from 15 to 30 drops, to assist their absorption. If the tincture is injected into the subcutaneous tissue, abscess may ensue. In goitre in dogs, calves and lambs, injections of tincture of iodine (♏x.) may be made every other day for 10 to 20 times—if painting on the tincture externally and potassium iodide or dessicated thyroid glands (gr. iii. in capsules thrice daily) internally are unsuccessful. Ozena may be treated to advantage by irrigation with a solution containing one drachm of the tincture of iodine to the pint of normal salt solution. In inflammation of the upper air passages, iodine is sometimes beneficial as a stimulant and antiseptic inhalation, which is pro-

duced by adding one-half a drachm of iodine to the pint of boiling water.

Uses Internal.—Iodine is thought to act more satisfactorily than potassium iodide in the treatment of diabetes insipidus or polyuria of the horse, in which it often appears to be a specific. One ounce twice daily, intratracheally, of Dieckerhoff's solution (iodine, 1; K I, 5; water 100) has given good results in purpura of horses.

Administration.—Iodine may be combined with gentian and iron in the form of a ball, as recommended by Finlay Dun, or better, given as Lugol's Solution, which is less irritating and more active.

POTASSII IODIDUM. Potassium Iodide. K I. (U. S. & B. P.)

Synonym.—Jodkalium, G.

Derivation.—Iodine is dissolved in hot liquor potassæ. $6\ I + 6\ K\ O\ H = 5\ K\ I + K\ I\ O_3 + 3\ H_2O$. The evaporated residue is heated with charcoal to remove O from K I O_3 (Potassium Iodate). $KIO_3 + 3\ C = KI + 3\ C\ O$. The result is purified by crystallization.

Properties.—Potassium iodide occurs in colorless, transparent or translucent, cubical crystals; or as a white, granular powder, having a slight odor of iodine, and a bitter, saline taste. Permanent in dry air, but slightly deliquescent in moist air. It is soluble in 0.7 part of water; in 12 parts of alcohol, and 2.5 parts of glycerin.

Dose.—H., ʒ ii.-iv. (8.-15.); C., ʒ vi. (24.); Sh. & Sw., gr.xv.-xxx. (1.-2.); D., gr.ii.-x. (.12-.6).

PREPARATION.

Unguentum Potassii Iodidi. (U. S. & B. P.)
10 per cent., U. S. P.
Unimportant in veterinary practice.

SODII IODIDUM. Sodium Iodide. Na I. (U. S. & B. P.)

Synonym.—Iodure de sodium, Fr.; jodnatrum, G.

Derivation.—Made from sodium hydrate in the same manner as potassium iodide.

Properties.—Occurs in colorless, cubical crystals, or as a white, crystalline powder, without odor, and having a bitter, saline taste. Soluble in 0.5 part of water and in 3 parts of alcohol.

Dose.—Same as potassium iodide.

Syrupus Acidi Hydriodici. Syrup of Hydriodic Acid. (U. S. P.)

Contains 1 per cent. of absolute H I.

Derivation.—Diluted hydriodic acid, 100; water, 300; syrup, 600.

Properties.—A colorless, odorless, syrupy liquid, of a sweet, acid taste.

Dose.—D., ♏ xv.-℥ i. (1.-4.).

Action External.—Potassium iodide is not absorbed unless rubbed into the skin with fat, and is not a local irritant, and therefore possesses very little value as an external application.

Action Internal.—Potassium iodide and iodine are both described by that unsatisfactory term, alterative. In certain diseases, as in rheumatism, iodine and the iodides alter nutrition and cause absorption of exudates in some unknown manner; hence the term alterative. Potassium iodide forms in the tissues soluble double salts with the metals and therefore is the antidote in chronic lead, arsenic, mercury and zinc poisoning in aiding their elimination. It is often taught that potassium iodide liberates iodine in the tissues, and that the latter forms soluble compounds with albumin, which are then readily eliminated; thus explaining the effect of potassium iodide in aiding resolution of morbid exudation and inflammatory thickenings. Free iodine is certainly formed in the body as it escapes into the stomach after administration of iodides. Supposed elimination of free iodine from the mucous membranes and skin is said to account for irritation of these parts after prolonged and excessive doses (iodism). Like other salts of the alkalies (see Sodium Chloride) the iodides are diuretics and, in concentration, may cause nausea and vomiting. The iodides are rapidly absorbed and mostly eliminated as such chiefly by the urine; but also by mucous membranes, and in milk, sweat, tears, etc.

Uses Internal.—Potassium iodide is useful in causing absorption of enlarged, lymphatic glands, and its action should be assisted by the application of iodine or red mercuric iodide externally. Potassium iodide in small doses, diminishes congestion and increases the fluidity and amount of secretion in acute laryngitis, acute and subacute bronchitis, and appears to possess an alterative action in improving the condition and nutrition of the bronchial mucous membranes. It resembles ammonium chloride in the latter respect. It is also of value in asthma, pulmonary emphysema, and chronic bronchitis, unassociated with copious secretion. Chronic pleuritis, pericarditis, and ascites are treated with potassium iodide, which assists absorption, and occasionally exerts a diuretic effect. Tardy

resolution of pneumonic consolidation is hastened by potassium iodide. Endocarditis with cardiac hypertrophy is said to be benefited by potassium iodide and digitalis.

Champignon, or scirrhus cord of horses, is sometimes cured by the sorbefacient powers of potassium iodide in full doses. Potassium iodide is of value in goitre of dogs, calves and sheep when tincture of iodine is used externally (see p. 228). "Roaring" and "thick wind" may be cured by the administration of potassium iodide. Potassium iodide is the drug commonly given for aneurism. Probably it is only of use when this is of syphilitic origin and not in animals. Potassium iodide is the best remedy known for actinomycosis. It should be given to the larger animals in doses of three drachms daily, or in the same dose as Lugol's Solution, until iodism appears, when the dose may be reduced to one-half this amount and continued two to six weeks. Iodine or Lugol's solution may be used in preference to potassium iodide on account of the great expense of the latter salt. Potassium iodide is one of the many remedies prescribed in chronic rheumatism. Potassium iodide has given good results in the treatment of periodic ophthalmia in horses with the first attack. They are given one ounce daily for two or three days, and kept in the dark with cold compresses over the eyes. Potassium iodide has a clinical reputation for its power to aid absorption and resolution in inflammation or effusions of the brain or cord, in hemiplegia, paraplegia and meningitis.

Summary.—Iodine and potassium iodide resemble one another in many respects. Iodine is a local irritant, potassium iodide is not. The known physiological action of potassium iodide and iodine does not explain their medicinal uses. In combating certain diseases, in an inexplicable manner, they are known as alteratives. In man, iodine is superior to potassium iodide in the treatment of scrofula. In the horse, iodine is considered of more value in the treatment of diabetes insipidus; while in both man and the lower animals, potassium iodide is regarded as more valuable in chronic rheumatism. In subacute rheumatism, one prescribes equal parts of sodium salicylate and iodide. The action of iodine in benefiting local disorders, when applied externally, is due to its counter irritant effect, rather than to absorption.

Administration.—Potassium iodide is given in solution. Sodium iodide and syrup of hydriodic acid are simply substitutes for potassium iodide.

IODOFORMUM. Iodoform. CHI_3. (U. S. & B. P.)

Derivation.—Alcohol, potassium carbonate, iodine, and water

are heated together. $C_2H_6O + 2\ KHCO_3 + 8\ I = 2\ CHI_3 + 2\ KI + 2\ CO_2 + 3\ H_2O$.

Iodoform contains over 90 per cent. of iodine.

Properties.—Small, lemon-yellow, lustreless crystals of the hexagonal system; having a peculiar and very penetrating persistent odor, somewhat resembling that of saffron and iodine, and an unpleasant and slightly sweetish and iodine-like taste. Very slightly soluble in water; soluble in 46.7 parts of alcohol, and in 5.2 parts of ether. Very soluble in chloroform, benzine, fixed and volatile oils.

PREPARATIONS.

Unguentum Iodoformi. Ointment of Iodoform (1-10). (U. S. & B. P.)
Suppositoria Iodoformi. (B. P.)
(Each containing 3 grs. of iodoform.)

Action External.—Iodoform is an antiseptic, local anesthetic, stimulant, protective, and dessicant agent. While iodoform does not inhibit the growth of germs outside the body—many of the bacteria growing in iodoform itself—it is nevertheless a valuable antiseptic. This result may probably be accounted for by the decomposition of iodoform on moist wounds, with the liberation of free iodine; by its absorption of exudates on which germs live; and possibly by neutralizing toxins. Iodoform is particularly useful in septic and suppurating wounds. When applied over extensive surfaces, absorption and poisoning may occur. The symptoms of iodoform poisoning are most diverse.

Symptoms of gastro-intestinal irritation are seen in poisoning in dogs, as vomiting, diarrhea and albuminuria, together with nervous symptoms, as convulsions, stupor and sleep. The pulse may be very rapid or infrequent; the temperature high or normal. Iodoform is in part absorbed unchanged, but the greater part is transformed into free iodine and iodides in the body. Fröhner states the poisonous dose for dogs is 15 grs. for each kilo of live weight. One drachm will poison a dog weighing ten pounds. 1½ ounces have killed a cow. Ecchymoses are found after death on the heart and kidneys, and there is congestion of the meninges.

The symptoms of poisoning are peculiarly diverse since the effects are due both to iodoform and to iodides and iodine set free in the body. The rapid pulse is due to stimulation of the thyroid gland by iodine. The mania and delirium characteristic of iodo-

form poisoning in man are not seen in animals. The application of iodoform to wounds is sometimes followed by an erythematous eruption and fever. Iodine is eliminated in the urine in iodoform poisoning and can easily be discovered by the starch test. General fatty degeneration of the internal organs is found after death. The local dessicant effect of iodoform on raw surfaces assists the antiseptic action, and the local anesthetic properties combine to make iodoform the best antiseptic powder we possess, barring the odor.

Action Internal.—The internal action of iodoform possesses no therapeutic value. Care must be observed to prevent animals licking off iodoform from the surface of the body.

Elimination.—Iodoform is eliminated in the form of iodine and iodides by all the secretions, chiefly by the urine as iodides.

Uses External.—Iodoform is of value applied over suppurating and septic surfaces, sores, and ulcers, where it hinders the growth of bacteria, stimulates unhealthy granulations, relieves pain, possibly neutralizes toxins, and certainly produces a vile odor. For this reason one of its substitutes should be employed when an antiseptic powder is desirable for use upon dogs living in or about dwellings. Iodoform is commonly employed in its purity. It may be mixed in any proportion with boric acid, or with tannic acid (1-8), for its astringent effect. It is valuable in foul of the foot in cattle, or in foot rot in horses, with equal parts of alum or tannic acid. Combined with collodion (1-15), it forms a useful dressing for sealing small wounds or abrasions upon the hands. The anesthetic action of iodoform is taken advantage of to relieve pain in fissure of the rectum, and hemorrhoids. Zuill recommends the following combination by insufflation in the early stages of inflammation of the frontal sinuses:

Iodoform, Magnesia, Silver Nitrate—equal parts.

Three grains may be used in suppositories for the smaller animals. Iodoform may cause healing in abscess—injected into the cavity with glycerin or vaseline—(1-10), using 2-4 drachms of the mixture for smaller animals, or 1 ounce for the larger animals. Iodoform is very efficacious in the treatment of local tuberculous lesions. Iodoform combined with lard or oil (1-10), is an excellent agent for burns which are not so extensive as to endanger the patient through absorption and iodoform poisoning.

Iodolum. Iodol. C_4I_4NH. (U. S. P.)

Synonym.—Tetraiodopyrrol.

Derivation.—Action of iodine on pyrrol in solution in alcohol. Contains 88.9 per cent. of iodine.

Properties.—Crystalline, shining, light, grayish-brown powder. Tasteless and odorless. Practically insoluble in water; soluble in 9 parts of alcohol, and in ether and fatty oils. The surgical use of iodol has led to poisoning through absorption, but the latter is so slow that the danger is exceedingly slight. Iodol is suitable for all purposes in which iodoform is indicated. It is too expensive for general use, but is preferable for application to dogs, on account of its lack of odor.

Aristolum. Aristol. $C_{20}H_{24}O_2I_2$.

Aristol is now official as Thymolis Iodidum, Thymol Iodide.

It is more correctly dithymol-diiodide, obtained by the conden sation of two molecules of thymol and the introduction of two atoms of iodine into the phenolic groups of the thymol; it contains 45 per cent. of iodine.

Properties.—A bright, chocolate-colored or reddish-yellow, bulky powder, with a very slight aromatic odor.

Insoluble in water and glycerin; slightly soluble in alcohol; readily soluble in ether, chloroform, collodion, and in fixed and volatile oils.

Aristol is inferior as an antiseptic to either iodoform or iodol. It is used with some benefit in dry, scaly skin diseases in powder or ointment. Aristol is useful on sores, wounds and ulcerations which have a tendency toward dryness as it seems to increase moisture. Other antiseptic dusting powders include acetanilid, bismuth subnitrate, salol and boric acid. Acetanilid has been shown to be a good antibacterial agent. It is cheap and may be applied pure, and it is an efficient substitute for iodoform. A few cases of poisoning have been reported following its extensive surgical use. Bismuth subnitrate and salol may induce poisoning when used over large surfaces. They are dessicants and feeble antiseptics. Boric acid is harmless and mildly antiseptic.

Orthoform. .Orthoform. (Non-Official.)

Orthoform is the methyl-erster of meta-amido-paraoxy-benzoic acid. It occurs as a white or dirty yellow, light powder, sparingly soluble in water and alcohol but more so in glycerin and solutions of the mineral acids. It may be combined with iodoform, aristol, boric

acid, salicylic acid, carbolic acid, turpentine and iodine without incompatibility.

Action.—Externally, orthoform exerts a powerful anesthetic effect on raw surfaces, but has little action on intact mucous membranes and none on the unbroken skin. It is also a mild antiseptic, of about the same value as boric acid. It is but feebly toxic and poisoning does not occur unless large quantities are applied over abraded surfaces. In the dog, 15 grains per 2 pounds of body weight have proved toxic when given by the mouth; and 7½ grains per 2 pounds of live weight are required to induce fatal poisoning. It appears to be a cerebro-spinal paralysant in these large doses. The anesthetic action of medicinal doses is usually prolonged, varying from a few hours to two or three days. Orthoform has been used extensively in human medicine for the past few years, and cases of poisoning have been of rare occurrence and none fatal, although as much as two or three ounces have been applied on ulcerated surfaces in a week's time. Occasionally the drug produces an erythema or dermatitis owing to peculiar susceptibility of the patient. On the other hand, orthoform has been used successfully in the treatment of dermatitis following poisoning in the human.

Uses.—Orthoform is valuable chiefly for its power in relieving pain when applied to raw surfaces. It is an excellent application for burns. In superficial burns, orthoform may be combined to advantage with ichthyol, of each 10 per cent., in lanolin. In burns of the second and third degree, the use of orthoform and boric acid, equal parts, forms an excellent remedy. Orthoform is serviceable in relieving pain and irritation of ulcers, hemorrhoids and fissures of the rectum. In human practice it is largely employed in connection with diseases of the nose, ear and throat to arrest pain after operations, and in ulceration and inflammation of these parts, as sore throat. Nasal gleet in horses should be benefited if not cured by the insufflation of the powder. Orthoform is commonly used in ointment containing 10 to 20 per cent. of the drug. It may be blown pure into cavities or applied as a saturated solution in collodion. It may be sprayed on a part with an atomizer in 5 per cent. solution with equal parts of alcohol and water. It has been injected into the bladder in cystitis mixed with water. In ulceration of the stomach, orthoform will give relief owing to its local anesthetic action. It may be administered mixed with water and syrup in the dose of 0.5-1.0 (7½-15-gr.) for dogs. It is an expensive drug at present.

SECTION X.

Sulphur.

Official Varieties.

Sulphur Sublimatum. Sublimed Sulphur. S. (U. S. & B. P.)

Synonym.—Flowers of sulphur, flores sulphuris, E.; fleurs (crème) de soufre, Fr.; schwefelblumen, schwefblüthe, G.

Derivation.—Obtained from native sulphur by sublimation.

Properties.—A fine, yellow powder, having a slightly characteristic odor and a faintly acid taste. Insoluble in water; slightly soluble in absolute alcohol; more readily soluble in benzine, benzol, oil of turpentine and many other oils; also in ether, chloroform, and in boiling, aqueous solutions of alkaline hydrates.

PREPARATIONS.

Sulphur Lotum. Washed Sulphur. S. (U. S. P.)

Synonym.—Sulphur depuratum, flores sulphuris loti, P. G.; soufre lavé, Fr.; gereinigte schwefelblumen, G.

Derivation.—Obtained from sublimed sulphur, which is treated with diluted ammonia water to wash out sulphurous and sulphuric and other impurities.

Properties.—A fine, yellow powder, without odor or taste. Solubility, same as sublimed sulphur.

Pulvis Glycyrrhizæ Compositus. Compound Powder of Glycyrrhiza. (U. S. P.)

Senna, 180; glycyrrhiza, 236; washed sulphur, 80; oil of fennel, 4; sugar, 500.

Dose.—Dogs (laxative), 3 ss.-i. (2.-4.).

Unguentum Sulphuris. Sulphur Ointment. (U. S. & B. P.)

Washed sulphur, 150; benzoinated lard, 850 (U. S. P.)

Sulphur Præcipitatum. Precipitated Sulphur. S. (U. S. & B. P.)

Synonym.—Lac (magisterium) sulphuris, milk of sulphur, E.; soufre précipité, lait de soufre, Fr.; Schwefelmilch, G.

Derivation.—Obtained from a solution of sublimed sulphur, 100; in boiling calcium hydrate, 50; by precipitation with hydrochloric acid. Calcium sulphide and hyposulphite are formed. $12\ S + 3\ Ca\ O_2H_2 = 2\ Ca\ S_5 + Ca\ S_2\ O_3 + 3\ H_2O$. Then: $2\ CaS_5 + Ca\ S_2\ O_3 + 6\ H\ Cl = 3\ Ca\ Cl_2 + 12\ S + 3\ H_2O$.

Dose (of sublimed, washed or precipitated sulphur).—H. & C., ʒ ii.-iv. (60.-120.); Sh. & Sw., ʒ i.-ii. (30.-60.); D., ʒ ss.-iv. (2.-15.).

Larger doses laxative; smaller for constitutional action.

Precipitated sulphur is the best preparation for internal use, as it occurs in a finer state of division and is more readily acted upon by the digestive juices. It may contain traces of sulphides or sulphureted hydrogen, owing to the method of preparation.

Action External.—Sulphur has no action upon the skin when applied in the pure state. The ointment is the most effective agent in destroying acari which produce mange, grease, and scab. Sulphur does not kill acari as readily as a sulphide which is formed by the addition of an alkali. When sulphur ointment is rubbed into the skin it causes considerable irritation and an artificial eczema. Sulphur is converted into sulphureted hydrogen and sulphurous acid by living tissue, and this transformation may occur to some extent when sulphur is rubbed into the skin with fat.

Action Internal.—Digestive Organs.—Sulphur is not acted upon by the stomach, but is somewhat dissolved by the alkaline intestinal juices, and converted in part into sulphides (10 to 20 per cent. of sulphur is absorbed as sulphides) and sulphureted hydrogen. The sulphides, together with sulphureted hydrogen, are absorbed into the blood. Minute traces of sulphureted hydrogen are eliminated by the lungs and skin, while oxidation of sulphides occurs in the tissues and they are eliminated as sulphates and unknown organic sulphur compounds. The sulphides and sulphureted hydrogen act as laxatives, and in all probability sulphur itself exerts a mild, mechanical irritation upon the bowels. Peristaltic motion and intestinal secretions are both slightly increased. The fecal discharges are soft and pasty, and offensive flatus containing sulphureted hydrogen escapes from the intestines after the administration of sulphur.

Constitutional Action.—Sulphur acts remotely during its elimination in stimulating the functions of the skin and respiratory mucous membranes,—so-called alterative action. Sulphur causes disorganization of the blood, and depresses and paralyzes the central nervous system after the continuous administration of colossal doses. Ordinary therapeutic quantities of sulphur have no effect of this kind.

Uses External.—Sulphur is mainly of service externally as a local stimulant and parasiticide in skin diseases. The female acarus, which produces mange (acariasis), bores under the epidermis and lays her eggs in the burrows, while the male insect remains upon the surface. It is essential, therefore, to remove the epidermis in order to expose the ova and female to the action of sulphur. The hair should be first shaved and the parts soaked and scrubbed with green soap and water. All cloths or brushes used in this operation should be burned or disinfected by boiling. Sulphur acts most efficiently in ointment, as fat fills up the burrows and deprives the insects of air. The official ointment is used in mange, but a combination with an alkali is more serviceable, unless there is active irritation of the skin. The following ointment is recommended:

Sulphur	2 parts.
Potassium carbonate	1 part.
Lard	8 parts.

This prescription is also useful in scab of sheep, and, diluted with 16 parts of lard, is curative in chronic eczema and grease. Sulphur is, however, chiefly used in dips for scab of sheep with lime (see p. 739).

In obstinate cases of ringworm or mange, the preparation mentioned by Brunton is of value. This consists of one part each of sulphur and oil of cade, with two parts each of green soap and lard. True follicular mange in the dog, if extensive and of long duration, is practically incurable by any drug. Sulphur ointment is of benefit in chronic eczema and acne, for its local stimulant and alterative action. For the treatment of foot rot in sheep the U. S. Agric. Dep't advises sulphur, 10 parts; cresol, 5 parts; with lard, 100 parts, and also in other forms of necrobacillosis, after removing scabs and necrotic tissue by the curette.

Uses Internal.—Sulphur is commonly used for its mild laxative action in convalescence, pregnancy and in the treatment of young animals and dogs suffering with constipation and hemorrhoids. It may be of service in chronic bronchitis with copious secretion. Sulphur is frequently prescribed internally for its action in chronic diseases of the skin, and is thought to exert a beneficial alterative action. Sulphur is also recommended in chronic rheumatism.

Disinfectant Action.—When sulphur undergoes combustion, sulphurous anhydride (SO_2) is evolved, and the latter combining with water forms sulphurous acid (SO_3) and sulphuric acid gas (H_2SO_4).

Sulphurous and sulphuric acid gas are strongly germicidal but

dry sulphur dioxide (SO_2) is practically without disinfectant action. Sulphurous acid owes its germicidal action to two properties. Chiefly to its being a powerful reducing agent, by which it is oxidized into sulphuric acid, and also to the acidity of both compounds. In withdrawing oxygen from organic matter it is poisonous to protoplasm in general and to bacteria in particular. Bacteriological experiments, however, show that dry, sulphur fumigation, as ordinarily employed for disinfection, is of little worth for destroying disease germs. To be effective for killing bacteria there should be moisture in the air to convert SO_2 into SO_3 and H_2SO_4. Generally formaldehyde disinfection is more efficient, but for killing animal life sulphur is much superior, as formaldehyde may not injure animals at all. Thus, for killing flies, fleas, mosquitoes, bedbugs, lice, mice and rats in barns, granaries, houses and ships, sulphur should be used. Sulphur destroys household fabrics, ornaments and utensils, but metal may be protected from its corrosive influence by a thin coating of vaseline. Cracks are covered by pasting paper over them, which may afterwards be washed off. The premises should be kept sealed 12 hours. Five pounds of flowers of sulphur should be used for each 1,000 cu. ft. or air space. Flowers of sulphur to the depth of 2 inches is put in pans 12 to 18 in. wide at the bottom, and with sides 4 or more inches high. Alcohol is poured over the sulphur to insure its combustion, which is started by throwing a lighted match upon the alcohol. The pans should float in 2 inches of water in larger pans to avoid fire and to supply moisture by evaporation of the water.

In employing sulphur as a disinfectant, animals must of course be removed from the premises. The burning of 1 lb. of sulphur in 1,000 cubic ft. of space will produce 1 per cent. of (SO_2) gas in the atmosphere. For killing insects and animals moisture is not desirable so that the pans containing sulphur may be placed directly upon sand on bricks.

Sulphurous anhydride has been employed for its local antiseptic and stimulant action, in inflammatory diseases of the upper air passages in horses. For this purpose it is burned in such quantities that the vapor is capable of being inspired because largely diluted with air. With such dilution the antiseptic action is lost, and there is danger of producing considerable irritation, and the procedure is of doubtful value. The same treatment has been pursued in verminous bronchitis of lambs and calves, caused by the Strongylus filaria and S. micrurus. Local treatment, with tracheal injection, is more efficient.

Acidum Sulphurosum. Sulphurous Acid. H_2SO_3. (U. S. & B. P.)

Synonym.—Acide sulfureux, Fr.; schwefelige säure, G.

Derivation.—Charcoal, 20, and sulphuric acid, 80, are heated together and the sulphurous anhydride evolved is passed into water. $4\ H_2SO_4 + 2\ C = 4\ SO_2 + 2\ CO_2 + 4\ H_2O$. $4\ SO_2 + 4\ H_2O = 4\ H_2SO_3$.

Properties.—A colorless liquid of the characteristic odor of burning sulphur, and of a very acid, sulphurous taste. It should contain not less than 6 per cent., by weight, of sulphurous anhydride, and not more than 94 per cent. of water.

Dose.—H. & C., ℥i.-ii. (30.-60.); Sh. & Sw., 5 i.-ii. (4.-8.); D., 5 ss.-ii. (2.-8.).

Actions and Uses.—Sulphurous acid decomposes organic matter, abstracts oxygen, and is transformed into sulphuric acid. The amount of sulphuric acid formed from the medicinal solution is not sufficient to interfere with its action in or upon the body. Sulphurous acid is a deodorant, deoxidizer, parasiticide and disinfectant externally. Solutions (1-4) are used as local stimulant and antiseptic applications to wounds, ulcers, or sores with foul discharges, and to kill the fungus growths producing ringworm.

Sulphurous acid is employed as an antiseptic in indigestion, associated with flatulence, and has the same effect and value as the sulphites and hyposulphites which are used for the same purposes.

Potassa Sulphurata. Sulphurated Potassa. (U. S. & B. P.)

Synonym.—Potassii sulphuretum, potassii sulphidum, liver of sulphur., E.; foie de soufre, Fr.; kalischwefelleber, G.

Derivation.—Powdered and dried potassium carbonate, 200, is mixed with sublimed sulphur, and heated in a crucible. Potassa sulphurata is a mixture of potassium thiosulphite and trisulphide. $3\ K_2CO_3 + 8\ S = K_2S_2O_3 + 2\ K_2S_3 + 3\ CO_2$.

Properties.—Irregular pieces of a liver-brown color, which by exposure to the air gradually absorb moisture, oxygen, and carbonic dioxide, and change to greenish-yellow and finally to a gray mass containing potassium carbonate, hyposulphite and sulphate. The compound has a faint odor of hydrogen sulphide, and a bitter alkaline taste. Soluble in 2 parts of water, with the exception of a small residue.

Dose.—H. & C., 5 ii.-iv. (8.-15.); D., gr. ii.-x. (.12.6.).

Action Internal.—Sulphurated potassa is composed chiefly of potassium trisulphide (K_2S_3) and of potassium thiosulphate ($K_2S_2O_3$). Its action is that of the sulphides generally. These give off H_2S in the bowel, which leads to purging and local irritation. When injected into a vein the sulphides induce two notable phenomena in toxic doses. First, they cause convulsions in mammals—owing to action on the cerebrum—and, in lethal doses, paralysis of the respiratory and vasomotor centres. Second, they produce alteration in the hemoglobin of the red corpuscles with formation of a body like methemoglobin and called sulpho-hemoglobin. In frogs this happens during life but in mammals apparently comes on immediately after death. Externally the sulphides in solution dissolves the horny epidermis and hair, and leads to irritation of the skin after prolonged action.

The sulphides undergo oxidation in the blood and escape in the urine as sulphates and organic sulphur compounds and in the breath and sweat as hydrogen sulphide. Sulphurated potassa has been administered internally as a substitute for sulphur, but is only of value externally.

Action and Uses External.—Sulphurated potassa is one of the most serviceable agents we possess in the treatment of chronic forms of skin diseases, as acne, lichen, but particularly eczema of the horse and dog. It is locally stimulant, alterative (?), and parasiticide. There is only one drawback to its general use, which is its exceedingly disagreeable odor. Peruvian balsam is frequently substituted for this reason in the treatment of skin diseases in dogs. A solution, "yellow lotion," is used in different strengths (1-8 to 1-15), according to the amount of stimulation which the skin will endure. The "yellow lotion" is a good agent for killing lice upon the skin. The following prescription will be found of benefit in canine practice:

℞

Potassæ Sulphuratæ	ʒ ii. ss.
Chloralis	ʒ ss.
Ol. Anisi	♏ii.
Aquæ ad	℥ iv.

M.

S. External use.

The chloral relieves itching and the anise disguises to some extent the odor of hydrogen sulphide.

SECTION XI.

Acids

Acidum Hydrochloricum. Hydrochloric Acid. HCl. (U. S. & B. P.)

(*Muriatic Acid.*)

Synonym.—Acidum hydrochloratum, S. chlorhydricum, E.; acide chlorhydrique S. muriatique, Fr.; salz saüre, G.

A liquid composed of 31.9 per cent., by weight, of absolute hydrochloric acid, and 68.1 per cent. of water. (U. S. P.)

Derivation.—Distil together sulphuric acid, sodium chloride and water. The resulting hydrochloric acid gas is passed into distilled water, while acid sodium sulphate remains in the retort and is further acted upon by sodium chloride. $2\ Na\ Cl + H_2S\ O_4 = H\ Cl + Na\ HSO_4$; then: $Na\ HSO_4 + Na\ Cl = H\ Cl + Na_2SO_4$.

Properties.—A colorless, fuming liquid, of a pungent odor and an intensely acid taste. Spec. gr., about 1.158 at 25° C. (77° F.) Miscible, in all proportions, with water and alcohol.

Incompatibles.—Alkaline and other carbonates, and lead and silver salts.

PREPARATIONS.

Acidum Hydrochloricum Dilutum, Acidum Nitrohydrochloricum, Acidum Nitrohydrochloricum Dilutum.

Acidum Hydrochloricum Dilutum. Diluted Hydrochloric Acid. (U. S. & B. P.)
(*Diluted Muriatic Acid.*)

Derivation.—Hydrochloric acid, 100; distilled water, 219. Diluted hydrochloric acid contains 10 per cent. of absolute hydrochloric acid. (U. S. P.)

Properties.—It does not fume in the air and is without odor. Spec. gr., 1.050. Otherwise corresponds to hydrochloric acid. (U. S. P.)

Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15.); Sh., 3 ss.-i. (2.-4.); Sw. & D., ♏x.-xxx. (.6-2.).

Acidum Sulphuricum. Sulphuric Acid. H_2SO_4. (U. S. & B. P.)

Synonym.—Oil of vitriol, E.; acide sulphurique, huile de vitriol, Fr.; schwefelsäure, vitriolöl, G.

A liquid composed of not less than 92.5 per cent. by weight of absolute sulphuric acid, and not more than 7.5 per cent. water.

Derivation.—Sulphurous anhydride, generated by roasting iron pyrites, or sulphur, is passed into leaden chambers. Nitric acid is introduced with steam, and the sulphurous anhydride undergoes oxidation and hydration. $2\ HNO_3 + 2\ SO_2 + H_2O = 2\ H_2SO_4 + N_2O_3$.

The nitrous acid combines with oxygen and water in the air, and is re-transformed into the nitric acid, acting continually as a carrier of oxygen to sulphurous anhydride.

Properties.—A colorless liquid, of oily consistence, inodorous, and very caustic and corrosive. Spec. gr. not below 1.826. Miscible, in all proportions, with water and alcohol, with evolution of so much heat that the mixing requires great caution. (U. S. P.)

Incompatibles.—Alkalies and carbonates, calcium and lead salts.

PREPARATIONS.

Acidum Sulphuricum Dilutum, Acidum Sulphuricum Aromaticum.

Acidum Sulphuricum Dilutum. Diluted Sulphuric Acid. (U. S. & B. P.)

Derivation.—Sulphuric acid, 100; distilled water, 825.

Properties.—Diluted sulphuric acid contains 10 per cent., by weight, of absolute sulphuric acid. Spec. gr. about 1.067. (U. S. P.)

Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15); Sh., 3 ss.-i. (2.-4.); Sw. & D., ɱx.-xxx. (.6-2.).

Acidum Sulphuricum Aromaticum. Aromatic Sulphuric Acid. (U. S. & B. P.)

Synonym.—Tinctura aromatica acida, P. G.; elixir vitrioli Mynsichti, elixir of vitriol, E.; élixir vitriolique, teinture (alcool) aromatique sulphurique, Fr.; säure aromatische tinctur, Mynsicht's elixir, G.

Derivation.—Sulphuric acid, 111 Cc.; tincture of ginger, 50 Cc.; oil of cinnamon, 1 Cc.; alcohol to make 1,000 Cc. (U. S. P.)

Properties.—Aromatic sulphuric acid contains about 20 per cent., by weight, of official sulphuric acid, partly in form of ethyl sulphuric acid. Spec. gr. about 0.933. (U. S. P.)

Dose.—H., 3 ss.-i. (2.-4.); C., 3 i.-ii. (4.-8.); Sh., ♏xv.-xxx. (1.-2.); Sw. & D., ♏v.-xv. (.3-1.).

Acidum Nitricum. Nitric Acid. HNO_3. (U. S. & B. P.)

Synonym.—Acide azotique, Fr.; salpetersäure, G.

A liquid composed of 68 per cent., by weight, of absolute nitric acid, and 32 per cent. of water.

Derivation.—Seven parts of sodium or potassium nitrate are distilled with four parts of sulphuric acid and water. $KNO_3 + H_2SO_4 = KHSO_4 + HNO_3$.

Properties.—A colorless, fuming liquid, very caustic and corrosive, and having a peculiar, somewhat suffocating odor. Spec. gr. about 1.403. (U. S. P.)

Incompatibles.—Alkalies and carbonates, iron sulphate, lead acetate and alcohol.

PREPARATIONS.

Acidum Nitricum Dilutum, Acidum Nitrohydrochloricum, Acidum Nitrohydrochloricum Dilutum.

I. Acidum Nitricum Dilutum. Diluted Nitric Acid. (U. S. & B. P.)

Derivation.—Nitric acid, 100; distilled water, 580. Diluted nitric acid contains 10 per cent., by weight, of absolute nitric acid. Spec. gr. about 1.054. (U. S. P.)

Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15.); Sh., 3 ss.-i. (2.-4.); Sw. & D., ♏v.-xxx. (3-2.).

II. Acidum Nitrohydrochloricum. Nitrohydrochloric Acid. (U. S. P.)
(*Nitromuriatic Acid.*)

Derivation.—Nitric acid, 180; hydrochloric acid, 820. Chemical composition uncertain.

Properties.—A golden yellow, fuming and very corrosive liquid, having a strong odor of chlorine. The strong acid should always be freshly prepared and should be used in preference to the diluted acid. It may be made off hand by mixing 4 parts of nitric acid with 16 parts of hydrochloric acid. The mixture should remain in an open bottle not more than half full, until the fumes pass off.

Dose.—H., ♏xx.-xl. (1.3-2.6); D., ♏iii.-v. (.2-.3).

III. Acidum Nitrohydrochloricum Dilutum. Diluted Nitrochloric Acid. (U. S. & B. P.)

(*Diluted Nitromuriatic Acid.*)

Synonym.—Acidum chloro-nitrosum. P. G.; aqua regia S. regis,—acide chloro-azotique S. chloro-nitreux, eau Regales, Fr.; salpetersalzsäure, königswasser, G.

Derivation.—Nitric acid, 40; hydrochloric acid, 182; distilled water, 780.

Properties.—A colorless, or pale yellow liquid, having a faint odor of chlorine and a very acid taste. Completely volatilized by heat. (U. S. P.)

Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15.); Sh., 3 ss.-i. (2.-4.); Sw. & D., ♏ v.-xxx. (.3-2.).

Acidum Phosphoricum. Phosphoric Acid. $H_3P\ O_4$. (U. S. & B. P.)

A liquid composed of not less than 85 per cent., by weight, of absolute orthophosphoric acid ($H_3P\ O_4$), and not more than 15 per cent. of water. (U. S. P.)

Derivation.—Heat phosphorus with diluted nitric acid till nitrous fumes cease. $P_3 + 5\ HNO_3 + 2\ H_2O = 3\ H_3\ PO_4 + 5\ NO$.

Properties.—A colorless liquid, without odor, but having a strongly acid taste. Spec. gr. not below 1.707. Miscible, in all proportions, with water or alcohol. (U. S. P.)

PREPARATION.

Acidum Phosphoricum Dilutum. Diluted Phosphoric Acid. (U. S. & B. P.)

Derivation.—Phosphoric acid, 100; distilled water, 750. (U. S. P.) Diluted phosphoric acid contains 10 per cent., by weight, of absolute orthophosphoric acid. Spec. gr. about 1057.

Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15.); Sh., 3 ss.-i. (2.-4.); D., ♏ v.-xxx. (.3-2.)

Acidum Aceticum. Acetic Acid. $H\ C_2H_3O_2$. (U. S. & B. P.)

Synonym.—Acetum purum,—acetum destillatum, P.G.; acide acétique dilué, Fr.; reiner essig, G.

A liquid composed of 36 per cent., by weight, of absolute acetic acid, and 64 per cent. of water.

Derivation.—Distillation of dry sodium acetate with sulphuric acid and crystallization of the distillate. $Na\ C_2\ H_3O_2 + H_2SO_4 = HC_2H_3O_2 + Na\ H\ SO_4$.

Properties.—A clear, colorless liquid, having a strong, vinegar-like odor, a purely acid taste and a strongly acid reaction. Spec. gr. about 1.045. Miscible with water or alcohol in all proportions.

PREPARATION.

Acidum Aceticum Dilutum. Diluted Acetic Acid. (U. S. & B. P.)

Synonym.—Acetum concentratum, acide acétique, Fr.; verdünnte essigsäure, G.

Derivation.—Acetic acid, 100; distilled water, 500. Diluted acetic acid contains 6 per cent., by weight, of absolute acetic acid. Spec. gr. about 1.008. Not employed internally except in the form of official aceta. Vinegar is impure diluted acetic acid, made by destructive distillation of wood, or by acetous fermentation and oxidation of alcoholic solutions, as cider.

$C_2H_5O\ H + O_2 = H\ C_2H_3O_2 + H_2O$. A temperature of 80° F., and the presence of the ferment or mould (Mycoderma aceti), are necessary.

Acidum Aceticum Glacial. Glacial Acetic Acid. $HC_2H_3O_2$. (U. S. & B. P.)

Synonym.—Acidum aceticum, P. G.; acidum aceticum concentratum, acetum glaciale,—acide acétique concentrée, esprit de vinaigre, vinaigre glacial, Fr.; essigsäure, eissesig, G.

Derivation.—Same as acetic acid.

Properties.—A clear, colorless liquid of a strong vinegar-like odor, and a very pungent, purely acid taste. Contains about 99 per cent. of absolute acid. Not used internally.

Acidum Tartaricum. Tartaric Acid. $H_2C_4H_4O_6$. (U. S. & B. P.)

Synonym.—Sal essentiale tartari, acide tartrique, acide de tartre, Fr.; weinsäure, weinsteinsäure, G.

Derivation.—Boil acid potassium tartrate or argol (incrustation in wine casks) with chalk to form calcium tartrate. $2\ K\ H\ C_4H_4O_6 + Ca\ C\ O_3 = Ca\ C_4H_4O_6 + K_2C_4H_4O_6 + H_2O + C\ O_2$. Add calcium chloride, which precipitates more calcium tartrate, and decompose with sulphuric acid. $H_2S\ O_4 + Ca\ C_4H_4O_6 = H_2C_4H_4O_6 + Ca\ S\ O_4$.

Evaporate solution. Calcium sulphate crystals separate and are removed, while tartaric acid crystallizes on further evaporation.

Properties.—Colorless, translucent, monoclinic prisms, or crystalline crusts, or a white powder; odorless, having a purely acid taste, and permanent in the air. Soluble in about 0.71 part of water, and in 1.67 parts of alcohol. Not commonly used in Veterinary medicine.

Dose.—H., 3 ii.-iv. (8.-15.); D., gr.x.-xxx. (.6-2.).

Acidum Citricum. Citric Acid. $H_3C_6H_5O_7$. (U. S. & B. P.)

Synonym.—Acidum citri S. limonum, S. limonorum, acide citrique, acide du citron, Fr.; citronensäure, G.

Derivation.—Usually prepared from the lemon (Citrus lemonum), or lime (Citrus bergamia). Boiling lemon juice (containing 7 per cent. of citric acid) is treated with chalk to form calcium citrate. $2\ H_3C_6H_5O_7 + 3\ Ca\ C\ O_3 = Ca_3\ (C_6H_5O_7)_2 + 3\ C\ O_2 + 3\ H_2O$.

Calcium citrate is boiled with sulphuric acid and the resulting citric acid is obtained by filtration, evaporation and crystallization. $Ca_3\ (C_6H_5O_7)_2 + 3\ H_2\ S\ O_4 = 2\ H_3C_6H_5O_7 + 3\ Ca\ S\ O_4$.

Properties.—Colorless, translucent, right-rhombic prisms; odorless, having an agreeable, purely acid taste; efflorescent in warm air and deliquescent when exposed to moist air. Soluble in 0.54 parts of water and in 1.55 parts of alcohol.

Dose.—H., 3 ii.-iv. (8.-15.); D., gr.x.-xx. (.6-1.3).

PREPARATION.

Syrupus Acidi Citrici. Syrup of Citric Acid. (U. S. P.)
Citric Acid, 10; water, 10; spirit of lemon, 10; syrup to make 1000.
Dose.—Ad lib.

Acidum Lacticum. Lactic Acid. $H\ C_3H_5O_3$. (U. S. & B. P.)

Synonym.—Acide lactique, Fr.; milchsäure, G.

An organic acid, usually obtained by subjecting milk-sugar or grape-sugar to lactic fermentation. Composed of 75 per cent., by weight, of absolute lactic acid, and 25 per cent. of water.

Properties.—A colorless, syrupy liquid, odorless, of a purely acid taste. Spec. gr. about 1.206. Freely miscible with water, alcohol, or ether.

Dose.—H., 3 ii.-iv. (8.15.); D., ♏xxx.-3 i. (2.-4.).

Other acids to be found in other sections.

Action External.—The concentrated mineral acids are powerful escharotics, but in dilution are stimulant, astringent, rubefacient, vesicant, according to their strength. Acids have a great affinity for the alkaline juices of the tissues and blood, and weak acid solutions are thus neutralized. Strong acids coagulate albumin, probably by combining with alkalies, which hold albumin in solution, and precipitating especially the globulins of the tissues. When mineral acids are present in abundance the albumin first coagulated is afterwards dissolved (except nitric acid), and the corrosive action of the acids is extensive. Acids further destroy tissue by combining with water, for which they have also a great affinity, particularly sulphuric and phosphoric acids. The former withdraws water to such an extent that the tissues are carbonized and blackened. Sulphuric acid is more destructive of tissue and acts more extensively than the other mineral salts. Nitric acid is less caustic, and hydrochloric acid is the least corrosive. Nitric acid stains the parts yellow, and hydrochloric, white. The vegetable acids, as citric and tartaric acids, are slightly caustic, but are irritant to the skin, and still more so to raw surfaces and mucous membranes. An ounce of tartaric acid has caused death in man through its local effect. The action of the caustic alkalies is more widespread than that of the mineral acids. Diluted sulphuric and nitric acids are astringents, because of their power of condensing tissues, and also hemostatics in causing compression of blood vessels by contracting of the tissues about them. Nitric acid is commonly employed externally, because its effect is limited by its own eschar, which is not dissolved by an excess of acid.

Hydrochloric acid has no astringent effect and is not used externally for its caustic properties. The acids are antiseptic, but are less appropriate than other agents in most cases, on account of their irritant action. Free hydrochloric acid as it exists in the gastric juice (0.2-0.3 of 1 per cent.) is a powerful antiseptic and even germicide.

Action Internal.—Alimentary Canal.—The classical experiments of Pawlow have materially altered our conceptions of the action of acids. We have shown (p. 17) that indirectly, by stimulating the formation of *secretin* in the stomach and intestines, they excite the activity of all the glands giving rise to the secretions concerned with digestive activity. They all aid digestion. Hydrochloric acid is particularly serviceable in gastric anacidity, being the natural acid of the gastric juice. The mineral acids also possess a certain degree of antiseptic action on the contents of the digestive

tract. Diluted acids are called refrigerants in imparting a sense of coolness to the skin and mucous membrane of the mouth, and, by augmenting the secretion of saliva, relieve thirst in fever. The acids exert a local stimulant and astringent action upon the intestinal canal. Nitric acid is particularly a stimulant, sulphuric acid an astringent.

Constitutional Action.—Almost all living matter possesses an alkaline or neutral reaction. An animal dies from acid poisoning even before its blood becomes neutral. The constitutional action of acids is seen after absorption of dilute solutions. Acids are immediately converted into salts—as acid can not exist as such in the tissues or blood. In the case of herbivora the fixed alkalies of the tissues and blood thus neutralize acid as it is absorbed. When the alkalies of the blood and tissues are consumed the animal dies. Herbivora are very susceptible to acid poisoning, as in them the lessened alkalinity of the blood renders it unable to carry carbonic acid from the tissues to the lungs.

When the tissues become flooded with carbonic dioxide, dyspnea, heart weakness, depression of the vasomotor centre, and death by failure of the respiration ensue.

Carnivora are more resistant to acid poisoning because they possess a protective power whereby they are able to liberate free ammonia from their tissues and thus neutralize absorbed acid and save —to a considerable extent—the fixed alkalies in their blood and tissues.

Acid is absorbed from the digestive tract as acid salts and in this form is eliminated by the kidneys, which may lead to renal irritation and the presence of albumin and blood in the urine.

The urine of herbivora therefore becomes strongly acid and contains large quantities of the salts of the alkalies; that of carnivora holds an excess of ammonia and—to a less degree—an increase in potassium and sodium salts.

The organic acids are also absorbed as salts of the alkalies but do not usually reduce the alkalinity of the blood or render the urine acid.

They are oxidized into carbonates in the tissues and may even alkalize the urine by their elimination as alkaline carbonates. The vegetable salts are infrequently used in veterinary medicine. The effect of the mineral acids on the body is due almost wholly to their hydrogen ion, to which they owe their activity.

Diluted phosphoric acid relieves thirst and forms an agreeable cooling drink in fevers. Phosphoric acid is used as a tonic and reconstituent, but experiments have shown that phosphorus compounds of the body can not be built from inorganic forms of phosphorus.

Poisoning.—If acid be spilled on the skin, alkalies should be applied, and in case of sulphuric acid the excess of acid should first be rubbed off, and then large quantities of very dilute alkaline solutions or soapsuds should be employed to avoid evolution of heat when the acid combines with water. When acids are swallowed, there is excoriation and sloughing of mucous membranes, difficulty in swallowing, vomiting of dark brown material and mucus (in animals capable of the act), severe colic, pain on movement, constipation, or, rarely, bloody diarrhea. Occasionally some acid flows into the larynx during deglutition and edema and suffocation rapidly ensue. There is inflammation of the upper part of the digestive canal, thirst, and collapse, with weak pulse and cold extremities. Softening, sloughs, hemorrhage and perforation of the mucous membrane of the mouth, gullet and stomach and small intestines are found post mortem.

Treatment.—Soapsuds, sodium bicarbonate, lime water, magnesia, or other alkalies. Demulcents, as milk, white of egg, gum arabic and linseed tea. Opium and stimulants. Wash out the stomach with a large amount of alkaline solution.

Uses External.—Strong mineral acids are used as caustics. One part of sulphuric acid is mixed with three parts of sulphur, or asbestos, to form a paste for the destruction of morbid growths.

The application of sulphuric acid is somewhat dangerous, as it is difficult to limit the action, and it is not by any means the best escharotic, nor so good as nitric acid, which produces less extensive destruction of tissue, and is a useful agent for the removal of tumors, for the cauterization of bites inflicted by rabid animals, and for the treatment of foul, sloughing wounds or foot-rot.

The action of nitric acid may be limited by surrounding the part to which the strong acid is applied with oil, or by washing the acid off with soapsuds. Glacial acetic acid is frequently employed to remove warts and small excrescences. It is not so powerful as sulphuric or nitric acid. The acids in weak solution (℥ i.-Oi.) are useful in relieving irritation of the skin, as in urticaria, for their astringent action upon piles, and to stop slight hemorrhages. Vinegar diluted with 3 parts of water may be used for the same purposes. Nitric acid (♏ v.-xxx. to ℥ i. of water) is a good antiseptic and astringent application to indolent ulcers, wounds, or, in the mouth, for ulcerative or mercurial stomatitis.

Uses Internal.—The acids are all of value in digestive disorders. Hydrochloric acid is useful in fever, to relieve thirst and aid digestion, when a few drops may be put in the drinking water. Hydrochloric acid is especially indicated for gastric indigestion with deficiency in the secretion of gastric juice, in convalescence, and for

fermentation and tympanites in chronic gastritis. This applies to chronic tympany with diarrhea in cattle when one to two drams may be given in the drinking water twice daily with salt and powdered nux vomica on the feed. Hydrochloric acid should be given after feeding, and is often combined with bitters. It acts as an antiseptic in addition to aiding digestion. Hypersecretion of hydrochloric acid, or hyperchlorhydria, is said to be characterized by acid reaction of the secretion in the mouth, and a desire to lick alkaline earthy matters. It is best treated by alkalies after feeding. All the acids are serviceable in the treatment of diarrhea and intestinal indigestion. Aromatic sulphuric acid (with opium) is more particularly valuable as a remedy for watery purging. Nitric and nitrohydrochloric acids are of more use in diarrhea with indigestion, jaundice, and disordered hepatic functions. The latter acid is often combined with nux vomica in the treatment of intestinal indigestion, and is a valuable remedy in catarrhal jaundice of dogs. The mineral acids are of service in preventing the formation of phosphatic calculi in horses.

Sulphuric acid is utilized in acute lead poisoning, as an antidote, to form insoluble sulphates in the bowels. The acids are given for their remote astringent action in arresting or preventing hemorrhage (purpura) from internal organs, and in diminishing excessive sweating and mucous discharges; but are inferior to other agents in the treatment of these conditions.

Administration.—The acids should be all thoroughly diluted with water for internal use.

Acidum Picricum. Picric Acid. $C_6H_2(NO_2)_3OH$.
(Non-Official.)

Synonym.—Acidum carbazoticum, carbazotic or nitrophenisic acid, trinitrophenol, E.; Acide picrique, carbazotique, nitroxanthique, Jaune-amer, Fr.; Pikrinsäure, trinitrocarbolsäure, welter'sches bitter, G.

Derivation.—Picric acid is made by mixing together equal parts of phenol and sulphuric acid and adding, to the resulting phenolsulphonic acid, nitric acid in a thin stream with constant stirring as long as nitrous fumes are given off.

Properties.—Picric acid occurs in bright yellow, inodorous scales or needles and, on being rapidly heated, will explode. It is soluble in 86 parts of water at 59° F., in 25 parts of boiling water which results in forming a saturated solution on cooling which contains about 1.2 per cent. of picric acid. It is readily soluble in chloroform and ether.

Action Internal.—When given internally picric acid stains the skin, mucous membranes and urine yellow and, in large doses, causes nausea, vomiting and purging, convulsions, hemolysis and death in collapse. It is eliminated as picramic acid. Its use in medicine is chiefly confined to its external action.

Action External.—Picric acid is a powerful germicide. Ehrenfried found the saturated aqueous solution fifty times more powerful than a one per cent. solution of phenol. While slightly irritating in saturated solution it soon produces a marked analgesic action which is persistent.

Solutions coagulate albumin and on raw surfaces a scab is quickly formed through coagulated serum. This effect is valuable on clean, fresh wounds and in granulating wounds and ulcers which are free from pus.

On suppurating surfaces the scab formed may only confine the pus. There is no agent in surgery which stimulates so effectually the process of epidermization or the formation of new skin. Picric acid possesses great osmotic power, solutions permeating rubber gloves.

Uses External.—Picric acid is commonly employed by dissolving it in the proportion of 3 drams to the quart of boiling water and the resulting sterile, saturated solution is then ready for use. It has been applied with success to sterilize the unbroken skin for operations. Its greatest field of usefulness lies in the treatment of burns of the first and second degree. After cleansing the burns with tincture of green soap and water and lysol solution, and pricking vesicles, strips of sterile gauze soaked in the saturated solution are applied and covered with sterile, absorbent cotton and bandage. On the third day the dressing is removed, after wetting with picric acid solution, and reapplied to remain a week. The same application is useful in fresh lacerated wounds and in ulcers and granulating surfaces, after suppuration has ceased.

The saturated solution is sometimes used to allay pruritus and as a stimulant in chronic eczema.

Uses Internal.—The potassium salt—potassium picrate—is occasionally administered as an anthelmintic. Young pigs, gr. iv.-viii. (0.24-0.5); lambs, gr. vii.-xx. (0.5-1.3).

Acidum Boricum. Boric Acid. H_3BO_3. (U. S. & B. P.)

Synonym.—Boracic acid, E.; acide borique, Fr.; acidum boracicum, sal. sedativum Hombergü, börsäure, G.

Derivation.—Made by evaporation and crystallization of solutions obtained by passing steam issuing from rocks in volcanic regions

of Italy, through water; or by the action of hydrochloric or sulphuric acids upon borax. $Na_2B_4O_7$ (borax) + 10 H_2O + 2 HCl = 4 H_3BO_3 + 2 NaCl + 5 H_2O. Recovered by filtration and recrystallization.

Properties.—Transparent, colorless scales, of a somewhat pearly lustre, or, six-sided triclinic crystals, or a light, white, very fine powder, slightly unctuous to the touch; odorless, having a faintly bitterish taste, and permanent in the air. Soluble in 18 parts of water and in 15.3 parts of alcohol; also soluble in 4.6 parts of glycerin. It is feebly acid.

Dose.—H., 3 ii.-iv. (8.-15.). Foals and calves, gr.xx.-xxx. (1.3-2.). D., gr.v.-xv. (.3-1.)

PREPARATION.

Glyceritum Boroglycerini. Glycerite of Boroglycerin. (U. S. P.)

Synonym.—Glycerinum acidi borici, B. P.; glycerite of glyceryl borate, solution of boroglyceride. Boric acid, 310; glycerin to make 1,000. Solution prepared by heat (302° F.)

Unguentum Acidi Borici. (10 per cent.) (U. S. & B. P.)

Sodii Boras. Sodium Borate. $Na_2B_4O_7$. (U. S. P.)

Synonym.—Borax, B.P.; natrum biboricum, boras, boras sodicus, E.; borate de soudre, Fr.; borsäures natron, G.

Derivation.—Natural deposits of the crude article occur as incrustations on shores of lakes in Nevada and California, which are purified by calcination and crystallization. Borax is also made by boiling boric acid with sodium carbonate. 4 $H_3B\ O_3$ + $Na_2C\ O_3$ = $Na_2B_4O_7$ + C O_2 + 6 H_2 O.

Properties.—Colorless, transparent, monoclinic prisms, or a white powder, inodorous and having a sweetish, alkaline taste. Slightly efflorescent in warm, dry air. Soluble in 20.4 parts of water at 77° F., and in 0.5 part of boiling water; insoluble in alcohol. At 176° F. it is soluble in one part of glycerin. Borax is slightly alkaline.

ACTION OF BORIC ACID AND BORAX.

Boric acid and borax are essentially mild, non-irritating antiseptics. These agents are practically harmless, as ordinarily employed, yet death in man has been reported from absorption of a 5 per cent. solution of boric acid used for irrigation of the large

cavities of the body, and fatalities have resulted from its external use and from the ingestion of quantities of boric acid.

Three drachms of boric acid may be given daily to dogs, without causing any untoward effect. In man, boric acid poisoning has been exhibited by feeble pulse, subnormal temperature, vomiting, erythema and swelling of superficial parts, muscular weakness, involuntary evacuations, coma, and disordered respiration. Boric acid is eliminated by the urine, sweat, saliva and feces. Borax tends to alkalize the urine, but neither borax nor boric acid are diuretics.

Boric acid and borax, like other antiseptics, relieve itching and destroy parasites upon the skin. Boric acid exerts an antiseptic action upon the contents of the digestive tract and upon the urine. It is thought to possess some emmenagogue action.

The value of boric acid and borax is chiefly surgical. They are employed more commonly upon the mucous membranes of the eyelids, mouth, nose, vagina, urethra and bladder, for their non-irritating, antiseptic properties, and also to relieve itching and to destroy parasites upon the skin. Boric acid is in more frequent use than any other agent in simple catarrhal conjunctivitis, and may be combined to advantage with cocaine as follows:

℞

Cocaine Hydrochlor.....gr.v.-x.
Acid. Borici.....gr.x.-xx.
Aquæ ad.....℥ i.
M.
S. Eye lotion.

Borax is perhaps more appropriate in the mouth, being alkaline. It is applied by swab, in saturated solution, for aphthous and other forms of stomatitis. A saturated solution (4 per cent.) of boric acid is useful as an injection for ozena, cystitis and vaginitis. Borax in saturated solution assuages pruritus ani and vulvæ, and is employed as an application for ringworm. Boroglyceride is indicated for burns and wounds.

A serviceable antiseptic dressing is made by soaking gauze in a boiling saturated solution of boric acid. The dried gauze contains boric acid, which crystallizes upon it as the solution cools. One of very best non-toxic wet dressings for wounds and ulcers consists of 2 parts saturated boric acid solution with 1 part of alcohol. One part of boric acid in combination with four parts of zinc oxide forms a soothing, protective dusting powder for chafed surfaces, intertrigo, erythema and moist eczema in dogs. Boric acid is prescribed in 10

per cent. ointment for burns, eczema and psoriasis. It is perhaps the best remedy for canker of the ear in dogs (otitis externa). The ear should be syringed out with a 2 per cent. solution, dried with absorbent cotton, and powdered with pure boric acid. The internal uses of boric acid are unimportant. It has been recommended and given as an emmenagogue, and as an intestinal antiseptic in fermentative diarrhea of foals and calves. Boric acid is often administered in human medicine to acidify the urine and disinfect the genito-urinary tract, although not so efficient as urotropin.

SECTION XII.

Class 1.—Carbon.

Carbon is represented officially as follows:

CARBO ANIMALIS. Animal Charcoal. (U. S. P.)

Synonym.—Bone black, E.; charbon, Fr.; thier (or) knochenkohle, G.

Derivation.—Bones freed from fat are exposed to great heat in close iron cylinders till ammoniacal vapors pass off. The resulting charcoal is pulverized and contains about 10 per cent. of carbon and 88 per cent. of calcium phosphate and carbonate.

Properties.—Dull, black, granular fragments, or a dull black powder; odorless, nearly tasteless, and insoluble in water or alcohol.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ ii.-iv. (8.-15.); D., gr.xx.-ʒ i. (1.3-4.).

PREPARATION.

Carbo Animalis Purificatus. Purified Animal Charcoal. (U. S. P.)

Derivation.—Animal charcoal, 100, is boiled with hydrochloric acid, 300, and water to remove ash. Result filtered and residue on filter paper washed and dried.

Properties.—A dull, black powder, odorless and tasteless; insoluble in water, alcohol or other solvents.

Dose.—Same as above.

Carbo Ligni. Charcoal. (U. S. & B. P.)

Synonym.—Wood charcoal.

Derivation.—Soft wood charred by piling it in heaps, igniting, and covering it with sand and turf to prevent rapid combustion.

Properties.—A black, odorless and tasteless powder, free from gritty matter. Insoluble in water or alcohol.

Dose.—Same as animal charcoal.

Action.—Charcoal is essentially a Deodorant and Absorbent. It possesses the power to absorb gases like other porous substances. Ordinarily it holds oxygen and when it comes in contact with decomposing matter it gives up its oxygen and at the same time absorbs the gaseous products of the decomposing substance. In this way it hastens the fermentation by oxidation and, while not a sufficiently powerful oxidizer to act as a germicide or antiseptic, yet it may favor the growth of aërobic rather than anaërobic organisms. The latter particularly produce foul-smelling and toxic bodies. So it may be seen that charcoal acts directly to absorb gases and indirectly to prevent the formation of the more undesirable fermentations. It was formerly thought that charcoal only acted as an absorbent in the dry state, but it is almost as efficient when wet.

Charcoal is not absorbed and escapes from the bowels unchanged. There is no material difference between the action of wood and animal charcoal. Externally charcoal acts as a Dessicant, Deodorant, and, indirectly, as an Antiseptic by absorption of the body fluids on which germs subsist. If administered continually in large quantities charcoal may produce mechanical obstruction in the bowels, and it is therefore employed in conjunction with laxatives.

Uses External.—Charcoal is applied as a dusting powder with astringents and antiseptics upon ulcers, galled and raw surfaces. The following combination is useful: charcoal, 4 parts; salicylic acid, 2 parts; burnt alum, 1 part. It is also used in flaxseed meal poultices upon foul, sloughing parts.

Uses Internal.—Charcoal is employed occasionally in indigestion, chronic gastric and intestinal catarrh, and diarrhea, accompanied by flatulence and mucous discharges. Charcoal possesses the power of attracting and holding alkaloids in its substance, and so may be used in large doses as an antidote in poisoning by alkaloidal drugs, as opium, nux vomica and aconite. Its action is slow, and other means, as tannic acid, emetics and the stomach tube, are more efficient.

CARBONEI DISULPHIDUM. Carbon Disulphide. $C S_2$. (U. S. P.)

Synonym.—Carbonii bisulphidum, bisulphide of carbon, carbon sulphide, E.; carboneum sulphuratum, alcohol sulfuris, P. G.; sulfude de carbone, Fr.; schwegelkohlenstoff, G.

Derivation.—Obtained from carbon and sulphur by distillation.

Properties.—A clear, colorless, highly refractive liquid; very diffusive, having a strong, characteristic, but not fetid odor, and a sharp, aromatic taste. Soluble in 526 parts of water; very soluble in alcohol, ether, chloroform, and fixed volatile oils. Spec. gr. 1.256 to 1.257. Carbon disulphide vaporizes readily and is highly inflammable.

Actions and Uses.—Carbon disulphide is a rapid and powerful anesthetic when inhaled, and also locally, when applied in spray upon the skin. It produces muscular weakness, coma, and, rarely, convulsions in toxic doses. It has been used as a counter-irritant in the form of vapor, to cause absorption of enlarged lymphatic glands. Favorable results have been reported by Perroncito, with carbon disulphide given in gelatine capsules to horses to destroy the larvæ of the bot fly (Œstrus equi). Two capsules containing 10 grams each for a horse and 8 grams each for a colt should be given two hours apart and followed in 12 hours by a pint of linseed oil. Walking the patient prevents colic. Strongyles are also killed by this agent.

Class 2.—Alcohol, Ether and Chloroform.

ALCOHOL. Alcohol. C_5H_2 O H. (U. S. P.)

Synonym.—Spiritus rectificatus, B. P.*; spiritus vini rectificatus, alcohol vini, rectified spirit, E.; alcool, Fr.; weingeist, G.; spiritus, P. G.

Alcohol is derived directly from fruit sugar, and indirectly from starch. The grains, as wheat, rye, corn; and potatoes, supply starch most economically. The starch in these substances is converted into glucose by heating with very dilute sulphuric acid, or by fermentation with malt. Glucose is further acted upon by yeast containing the Torula cerevisiæ, which converts 15 per cent. of glucose

* Rectified spirit (B. P.) contains 90 per cent. of pure alcohol by volume (85.65 per cent. by weight). There are four official dilutions in the B. P. containing 70, 60, 45 and 20 per cent. of alcohol by volume respectively.

into alcohol and carbonic dioxide. $C_6H_{12}O_6 = 2\ C_2H_5\ O\ H + 2\ CO_2$.

The weak alcohol resulting is subjected to repeated distillation until sufficiently pure and concentrated. In the natural fermentation of fruit sugar in grape juice, during the formation of wine, the amount of alcohol is self-limited to 15, rarely 20 per cent., since the ferment is killed by an amount of alcohol greater than this.

Derivation.—The official alcohol is derived from rectified spirit, by maceration, first with anhydrous potassium carbonate, then freshly fused calcium chloride, and finally by distillation.

Properties.—A liquid composed of about 92.3 per cent., by weight, or 94.9 per cent., by volume, of ethyl alcohol ($C_2H_5O\ H$), and about 7.7 per cent., by weight, of water (U. S. P.). A transparent, colorless, mobile and volatile liquid, of a characteristic, rather agreeable odor, and a burning taste. Spec. gr. about .816 at 15.6 C. (60° F.). Miscible with water in all proportions and without any trace of cloudiness. Also miscible with ether or chloroform. It is readily volatile at low temperatures, and boils at 78° C. (172.4° F.). It is inflammable and burns with a blue flame.

Dose.—H. & C., ʒ i.-iii. (30.-90.); Sh. & Sw., 3 ii.-iv. (8.-15.); D., 3 i.-ii. (4.-8.).

PREPARATION.

Alcohol Dilutum. Diluted Alcohol. (U. S. P.)

A liquid composed of about 41.5 per cent., by weight, or about 48.9 per cent., by volume, of absolute ethyl alcohol ($C_2H_5\ O\ H$), and about 58.5 per cent. of water. (U. S. P.)

Derivation.—Alcohol, 500; distilled water, 500.

Alcohol Absolutum. Absolute Alcohol. $C_2H_5O\ H$. (U. S. & B. P.)

Ethyl alcohol, containing not more than 1 per cent., by weight, of water.

Derivation.—Percolation of the purest alcohol through quicklime, out of contact with the air, and redistillation in vacuo.

Properties.—Transparent, colorless, mobile and volatile liquid, of a characteristic, rather agreeable odor, and a burning taste. Very hydroscopic. Spec. gr. not higher than 0.797 at 15.6° C. (60° F.)

Alcohol Deodoratum. Deodorized Alcohol. (Non-official.)

A liquid composed of about 92.5 per cent., by weight, or 95.1 per cent. by volume, of ethyl alcohol (C_2 H_5 O H), and about 7.5 per cent., by weight, of water.

Derivation.—Distillation of alcohol with about 2 per cent. of pure fused sodium acetate.

Properties.—Similar to alcohol, except as regards odor.

Spiritus Frumenti. Whisky. (U. S. P.)

Synonym.—Eau-de-vie de grains, Fr.; kornbranntwein, G.

Derivation.—An alcoholic liquid obtained by the distillation of the mash of fermented grain (usually of mixtures of corn, wheat and rye), and at least four years old.

Properties.—An amber-colored liquid, having a distinctive odor and taste, and a slightly acid reaction. Its specific gravity should not be more than 0.945, nor less than 0.924, corresponding, approximately, to an alcoholic strength of 37 to 47.5 per cent. by weight, or 44 to 55 per cent. by volume. Contains no more than traces of fusel oil. The alcoholic liquors owe their flavor or bouquet to ethers which are only developed in course of time. The amylic alcohol, or fusel oil in whisky is therefore converted into ethers, which give the characteristic flavor to whisky.

Dose.—H. and C., ʒ ii.-iv. (60.-120.); Sh. & Sw., ʒ i.-ii. (30.-60.); D., ʒ i.-iv. (4.-15.).

Spiritus Vini Gallici. Brandy. (U. S. & B. P.)

Synonym.—Spirit of French wine, E.; eau-de-vie, cognac, Fr.; Frantzbranntwein, G.

Derivation.—An alcoholic liquid obtained by the distillation of the fermented unmodified juice of fresh grapes, and at least four years old.

Brandy is somewhat astringent and is often not made from the distillation of wine, but is a factitious preparation. Native brandy is said to be purer, but is usually inferior in flavor to that of foreign manufacture. Brandy contains 39-47 per cent. of absolute alcohol by weight; 46-55 per cent. by volume.

Dose.—Same as that for whisky.

Spiritus Juniperi Compositus. Compound Spirit of Juniper. (U. S. P.)

Derivation.—Oil of Juniper, 8; oil of caraway, 1; oil of fennel, 1; alcohol, 1,400; water to make 2,000.

Compound spirit of juniper is similar to gin in its therapeutic action. Contains about 15 per cent. more alcohol. Gin is made by distillation of fermented malt and juniper berries. Gin differs from the other alcoholic preparations therapeutically in being more diuretic.

Dose.—Same as that for whisky.

Rum. (Not official.)

Rum is made from a fermented solution of molasses by distillation. It contains, by weight, from 40 to 50 per cent. of absolute alcohol. Rum does not differ physiologically from alcohol. There is no authoritative Latin name for rum.

Dose.—Same as that for whisky.

Vinum Album. White Wine. (U. S. P.)

Derivation.—An alcoholic liquid made by fermenting the juice of fresh grapes, the fruit of Vitis vinifera (nat. ord. vitaceæ), free from seeds, stems, and skins.

Properties.—A pale amber or straw-colored liquid, having a pleasant odor, free from yeastiness, and a fruity, agreeable, slightly spirituous taste, without excessive sweetness or acidity. The Pharmacopœia (1890) directs that the wine should contain from 7 to 12 per cent., by weight, of absolute alcohol. California Hock and Reisling, Ohio Catawba, Sherry, Muscatel, Madeira and the stronger wines of the Rhine, Mediterranean, and Hungary, come within the pharmacopœial limits. Wines containing more than 14 per cent. of alcohol, are usually fortified, *i.e.,* have alcohol or brandy added to them, and much imported Sherry and Madeira contain 15 to 20 per cent., by weight, of absolute alcohol.

Vinum Rubrum. Red Wine. (U. S. P.)

Derivation.—An alcoholic liquid made by fermenting the juice of fresh colored grapes, the fruit of Vitis vinifera (nat. ord. vitaceæ), in presence of their skins.

Properties.—A deep-red liquid, having a pleasant odor, free from yeastiness, and a fruity, moderately astringent, pleasant and slightly acidulous taste, without excessive sweetness or acidity. Should contain not less than 7, nor more than 12 per cent., by weight, of alcohol. Native Claret, Burgundy, Bordeaux, and Hungarian wines may be included within the pharmacopœial limits of vinum rubrum. Port (vinum portense) is fortified with brandy during fermentation, and contains 15 to 25 per cent. by weight, of absolute alcohol. Port is astringent from tannic acid in the grapes, skins and stalks, or the astringency may be due to logwood.

Red wines are said to be rough, contain tannic acid and therefore are astringent. Dry wines are those which contain little sugar. The wines develop ethers with age, and these improve their flavor and action.

Champagne contains about 10 per cent. of absolute alcohol and carbonic acid gas, which acts as a local sedative upon the stomach. Ale, stout and beers contain from 4 to 8 per cent. of alcohol, together with bitters and malt extracts. Cider contains 5 to 9 per cent. of absolute alcohol. Imported Sherry (vinum xericum, B. P.), 15 to 20 per cent. of absolute alcohol. Alcohol is the solvent most commonly employed in pharmacy, dissolving alkaloids, resins, volatile oils, balsams, oleo-resins, tannin, sugar, some fats and fixed oils.

Action External.—When applied in dilution to mucous membranes, raw surfaces or wounds, alcohol is a stimulant and local anesthetic; while in concentration, it is irritant and even caustic, coagulating mucus and albumin. If alcohol is allowed to evaporate from the unbroken skin, cooling of the surface and contraction of the superficial blood-vessels ensue, with diminished secretion of sweat; but when alcohol is rubbed into the skin, it is absorbed, takes up water, hardens the integument and causes temporary vascular dilatation. Alcoholic aqueous dilutions containing 60 to 70 per cent. of absolute alcohol are among the most valuable skin disinfectants. Absolute alcohol, or the undiluted commercial alcohol, have no germicidal action on dry bacteria, and alcohol in less than 40 per cent. strength is too weak. Alcohol is equal in germicidal action to 3 per cent. carbolic acid solution.

Action Internal.—Alcohol acts locally upon the mucous membrane of the alimentary canal, as described above, and if swallowed in concentration it produces congestion and white patches in the mouth by coagulating albumin upon the mucous membrane. The secretion of saliva is increased. In small doses the more powerful alcoholic liquors, as whisky and brandy, aid digestion by stimulating locally the gastric circulation, secretion, movement and appetite.

Alcohol, except in great dilution, tends to inhibit the action of

the digestive ferments—gastric and pancreatic—and in so far antagonizes its beneficial influence on gastric digestion just noted. So, while often aiding digestion, alcohol may fail on this account in some cases.

In large amounts, alcohol destroys the action of the peptic and pancreatic ferments, causes inflammation of the walls of the stomach and perverts the normal secretion into a mucous discharge. Alcohol is slightly astringent in the digestive tract, and may relieve pain by its local anesthetic action upon the stomach, and spasm, by stimulating the nervous mechanism controlling the stomach and bowels, and so co-ordinating the peristaltic movements.

Circulation.—The reputation of alcohol as a circulatory stimulant has been much dimmed by the results of many experimenters who have found it has no stimulating action on the heart whatever. Still more recent work shows that alcohol has a mild stimulating action on the heart—especially when nutrition is low—probably by providing the heart muscle with assimilable nutriment.

The reason for the supposition that alcohol is a heart stimulant was based on its action in increasing the pulse rate in man. In animals diluted alcohol does not affect either the rate or force of the heart, except in poisonous doses, when the pulse is slowed and weakened, owing to weakening of the cardiac systole and dilatation of the heart cavities. In man the increased pulse rate is attributable to muscular and mental activity produced by alcohol.

The blood pressure is not materially altered by medicinal doses of alcohol. Alcohol raises blood pressure, however, after section of the cord cuts off vasomotor action. More delicate apparatus also shows that the output of the isolated heart is greater under alcohol. Marked dilatation of peripheral vessels following the use of alcohol, is seen in the flushing of the face in man.

Redistribution of blood occasioned by alcohol appears to be of signal value in certain morbid conditions, as chills. In fever the slowing of the pulse, sometimes produced by alcohol, is thought to be due to its quieting effect on the central nervous system.

There is a transient stimulation of the heart induced by the ingestion of strong alcoholic solutions in acting reflexly on the circulatory centres through irritation of the upper alimentary mucous membrane.

Large doses of alcohol depress and paralyze the vaso-constrictor centres and heart muscle.

Respiration.—The respiration is not appreciably influenced by medicinal doses of alcohol in animals. In man slight reflex stimulation occurs, with increase in rate, owing to peripheral excitation

of the alimentary tract. Enormous doses paralyze the respiratory centres.

Temperature.—The temperature, both in health and fever, may be lowered by alcohol, because alcohol causes relaxation of the peripheral blood-vessels and loss of heat by radiation from the skin. The larger the quantity of alcohol ingested, the greater the fall of temperature.—In alcoholic narcosis, vasomotor paralysis and lessened movements lead to great loss of heat, particularly if the animal be at the same time exposed to cold. In small doses, alcohol may sometimes increase the temperature in man by leading to excitement and muscular movements, but the sensation of warmth perceived in man following the use of alcohol is generally fallacious, and is simply due to flushing of the vessels of the skin and stomach. Some of the lowest temperatures ever observed have been in drunken persons exposed to cold.

Tissue Change.—Metabolic activity is not altered to any degree by the action of alcohol in ordinary amounts. In serving as a non-nitrogenous food, of course, alcohol may influence carbonic dioxide exhalation as do other foods of its kind. But the drug does not exert a specific depressing action on the blood corpuscles or cell protoplasm to hinder oxidation, as it was formerly thought.

Deductions drawn from the action of alcohol on tissue change as shown by carbonic dioxide and urea elimination are faulty. Alcohol increases or diminishes tissue change and oxidation only in proportion as it stimulates or interferes with muscular movement. Under the influence of alcohol more nitrogen escapes as uric acid and less in the form of urea.

Nervous System.—Moderate doses of alcohol stimulate, while excessive quantities depress and paralyze the nervous system. This action is similar to that exerted upon the circulatory organs. The local effects of alcohol upon the peripheral nerves resembles the action after absorption upon the system generally. The nervous system is affected in nearly the same order and manner as by anesthetics, and the same stages may be observed. The stages include the stimulant, depressant and paralytic. The law of dissolution is demonstrated by alcohol, as the more highly organized centres, and those more recently developed in the process of evolution are the first to succumb, and following out this order the medulla, the first of the higher centres to be developed, is the last to be influenced by the drug. In accordance with this law the cerebrum is first acted upon. The period of excitement is brief and is due in a considerable degree to the increased cerebral circulation and flushing of the brain. It is essential to emphasize the fact that by far the most apparent and

decided action of alcohol is one of depression upon the nervous system as a whole. Many experimenters—as Schmiedeberg and Bunge—affirm that alcohol acts only as a depressant to the nervous system from the very outset. An increasing mass of evidence corroborates this view. The apparent enhanced mental activity in man is, according to this theory, simply due to lack of inhibitory control over the higher cerebral centres. Hence the freedom of speech and lack of modesty. Similarly the activity of the spinal reflex centres is thought to follow failure of inhibition. The mental excitement in man is chiefly due to exciting surroundings and does not occur in many persons nor in animals.

While the fact that alcohol is no more a nervous than a circulatory stimulant is now being generally accepted, the author has not yet seen fit to change his original statements in this book.

Alcohol has certainly an apparent primary stimulating effect on nerve centres and it is yet to be positively proven that alcohol has no real, actual stimulating effect on the nervous system. The stimulating influence of alcohol upon the spinal centres is more marked in the lower animals than in man, because the brain is proportionately small and poorly developed in the former. The primary stimulating effect of alcohol is shown in man by increased mental activity and apparent brilliancy, but acute reasoning and judgment are not enhanced, and in many cases there is almost immediate mental confusion and drowsiness induced. In man there is emotional excitement and the functions of speech and imagination are stimulated in the primary stage, but depression is soon noted in the loss of judgment and reasoning power, emotional control, decent restraint and speech. The patient cries, shouts, sings or laughs and talks incoherently. In the lower animals the stimulation of the higher and sensory psychical cerebral centres, with exhilaration, is rarely observed, but depression is seen in stupor and muscular incoördination. Stimulation of the cerebral motor centres is shown by motor excitement.

In man, following the symptoms described above, there is incoördination of muscular movements, first of those more highly and recently organized, such as are employed in writing, and then the muscular movements more remotely developed are affected, and the person is unable to walk, and finally there is complete paralysis of the motor centres and muscles. The staggering and uncertain gait of drunken people occurs not only because the cerebral motor and cerebellar centres are depressed by alcohol, but also because of loss of sensation and touch, or muscular sense, which is essential in maintaining the equilibrium. In relation to the spinal cord, primary stimulation of the reflex centres is more marked in animals than in

man, as has been pointed out. In animals this stimulation causes motor excitement, so that the patient trembles, jumps about, or strikes out with the feet. Depression of the reflex centres occurs in the latter stage of poisoning, and is exhibited by involuntary defecation and micturition; sensation and voluntary motion are lost. The motor nerves and muscles are not generally paralyzed, except by the local action of alcohol. The medulla finally becomes depressed and paralyzed, so that respiration, which is first stimulated, now fails, and the heart muscle becomes paralyzed and its action ceases.

The action of alcohol upon the nervous system may be summarized with a fair degree of accuracy, as stimulation and then depression of the parts enumerated below, and in the following order:

Cerebral psychical centres.
Cerebral sensory centres.
Cerebral motor centres.
Cerebellum.
Spinal centres.
  Sensory, reflex and motor.
Medullary centres.
  Vasomotor (early depression).
  Respiratory.

Horses and dogs are comparatively susceptible to alcohol, ruminants slightly so. An amount of alcohol equivalent to a pint of whisky has killed a sound horse, while four ounces of whisky will cause death in dogs if vomition be prevented by ligature of the esophagus.

Primary motor excitement is followed by unsteady, staggering gait, and coma in fatal cases.

Skin.—Alcohol dilates the peripheral vessels, and therefore brings more blood to the sudoriparous glands, and excites their functional activity. It is thus a diaphoretic.

Kidneys.—Alcohol acts as a diuretic. The exact mode of this action is unknown.

Nutrition.—Alcohol is a food, and, like other non-nitrogenous foods, supplies force and energy in its oxidation, takes the place of fats and carbohydrates, and may form fat in the body. It also protects food and tissue proteids from combustion. We are ignorant of the fate of alcohol after absorption, but we do know that the greater portion is decomposed and is not eliminated. Alcohol is most advantageous as a food in fever, or in conditions associated with weak digestion, since it is readily absorbed and assimilated. Alcohol causes dulness and lessened power for mental or physical work in man, and in normal conditions is not a desirable food unless there is a deficiency in the ordinary diet. In acting as a substitute for fat and carbohydrates, alcohol assists the accumulation of fat.

Elimination.—When alcohol is ingested in ordinary doses it is practically all consumed, and none but the most trivial amount is eliminated, *i.e.,* five to ten per cent. The greater the quantity absorbed the larger the amount eliminated by the urine, breath, sweat and feces, both relatively and absolutely; but under no circumstances after the most enormous doses does the elimination exceed 25 per cent. of the quantity ingested. Milk is not affected in quality or quantity through the ingestion of alcohol by the animal secreting it.

Summary.—Alcohol is externally refrigerant, astringent, anhidrotic and antiseptic, and if applied so that absorption occurs, it is rubefacient. On raw surfaces it is slightly anesthetic. Alcohol is internally a stomachic, carminative and slight local anesthetic in the digestive tract. Alcohol is reflexly a heart stimulant through its irritant action on the alimentary tract before absorption. It also is a direct, mild stimulant to the heart. Alcohol is a narcotic and its chief action is in progressively depressing and paralyzing nerve centres. It supplies force and is a food. Alcohol is a diuretic, diaphoretic, and antipyretic in dilating peripheral vessels and in causing sweating.

Acute Poisoning.—In coma and muscular relaxation, the treatment consists in emptying the stomach by the tube, in the external application of heat and counter-irritants; while strychnine, digitalone and atropine should be given subcutaneously and followed up with ammonia by the mouth.

Uses External.—Alcohol is applied to the unbroken skin to bruises, for its local refrigerant and astringent action in relieving pain and congestion. Diluted to 70 per cent. strength, alcohol forms an antiseptic and local anesthetic application to wounds, and like most antiseptics, relieves itching, particularly when combined with 1 to 2 per cent. of carbolic acid. Alcohol diluted with one-third part of water makes one of the best known agents for disinfection of the hands and operative field. It is relied upon entirely in some of the best hospitals in the country, in addition to thorough scrubbing in soap and water.

Uses Internal.—Digestive Tract.—Alcohol is a useful remedy to promote appetite and assist digestion. The drug should be given immediately before eating or with the food, properly diluted, and often advantageously with egg and milk during fever or convalescence from acute diseases. Alcohol is frequently combined with bitters, as compound tincture of gentian, when employed as a stomachic.

Acute Diseases.—Alcohol finds its greatest field of usefulness in the treatment of febrile diseases, notably influenza and strangles, bronchitis and pneumonia in horses. In such conditions it flushes

the vessels of the skin and distributes the blood more equally, allowing the heart to receive more blood and thus overcoming internal congestion.

It is impossible to reconcile the clinical remedial effects of alcohol with its action on healthy animals. The results of recent researches—especially as showing an absence of stimulation of the circulation and respiration by alcohol—has led to its lessened use as a therapeutic remedy. Nevertheless the enormous practical experience of some of the most acute clinicians of the past and present, that alcohol renders service in the diseases named herein, does not permit one to hastily sweep it aside as a therapeutic agent. We may summarize its worth in acute diseases as follows. It is a food and one which is not only digestible but which in itself may aid digestion. It has more food value than sugar. It dilates peripheral vessels and equalizes the circulation. In man one of its most potent effects is probably in acting as a narcotic and quieting the nervous system.

A high temperature does not contra-indicate its use, but it is not desirable in the early stages of acute inflammatory disorders. Alcohol is particularly serviceable in asthenic diseases—as purpura —and in continued fevers associated with much depression—as in puerperal and other forms of septicemia.

In fevers alcohol sometimes causes the heart to beat more slowly. Whether this be due to stimulation of the inhibitory apparatus or invigoration, directly or indirectly, of the weakened organ, we do not know.

The pulse, respiration and nervous system are our guides, and the object is to bring the functions into a more normal condition. Alcohol should therefore reduce the frequency of the pulse and respiration, when they are too rapid, and should cause the animal to become quieter. If these results are obtained, the use of the drug should be persisted in; if otherwise, administration should be stopped. Small and repeated doses are more appropriate in fever.

Alcohol is one of the most rapidly effective agents at our command in syncope and cardiac failure from various causes—as surgical shock, severe hemorrhage, collapse, exhaustion, snake bite, and following exposure to cold. In these conditions it should be given in the form of spirits diluted with only an equal part of very hot water. It may act in these cases by stimulating reflexly the medullary, cardiac and respiratory centres by its irritant action on the alimentary tract. From our physiological data alcohol should not be of service in such conditions as a stimulant. Its narcotic action in serving as a nervous sedative in lessening anxiety and pain and so offsetting the effects of shock—may account in some measure for its

worth. Thus morphine is one of the best drugs to use in surgical shock—even better than alcohol. After exposure to cold it is easy to explain the benefit derived from alcohol in its action in dilating the peripheral vessels and directly antagonizing the results of cold. Experiments on healthy animals regularly receiving moderate doses of alcohol have proved that they are more susceptible to inoculation with bacteria and toxins than controls. In disease, however, clinicians greatly differ on this point, Hare even going so far as to claim his experiments show that alcohol increases the power of the blood to overcome germs in disease. Here again the results of the effects of alcohol in health and disease clash.

Administration.—Veterinary practitioners are fortunately exempt from any moral considerations in relation to their medicinal use of alcohol. Rum, gin and whisky are more commonly employed than the other alcoholic preparations, although diluted alcohol is practically as valuable. Gin is indicated when a diuretic action is important. Brandy, being more astringent, is given to dogs with diarrhea, and, combined with cracked ice in small quantities, relieves vomiting. Sherry may also be administered to dogs with advantage. The dose of the various alcoholic liquids depends upon the quantity of alcohol contained in them.

Animals will usually take alcoholic preparations voluntarily if largely diluted with water, milk or gruel. Whisky should be diluted with about 4 parts of water when given in drench, unless the reflex action is desired, when it is administered in considerable doses with an equal amount of hot water.

Diluted alcohol, undiluted whisky or brandy are injected subcutaneously when a rapid action is imperative.

ÆTHER. Ether. $(C_2H_5)_2O$. (U. S. P.)

Synonym.—Æther purus, B. P.; æther fortior, pure ether, E.; éther hydrique pur, Fr.; reiner æther, G.

A liquid composed of about 96 per cent., by weight, of absolute ether or ethyl oxide $[(C_2H_5)_2O]$, and about 4 per cent. of alcohol containing a little water.

Derivation.—Obtained by distillation of alcohol with sulphuric acid. There are two steps in the production of ether; sulphovinic acid and water are formed in the first step. $H_2SO_4 + C_2H_5OH = C_2H_5, HSO_4 + H_2O$. Sulphovinic acid is then further acted upon by alcohol.

$C_2H_5, HSO_4 + C_2H_5, OH = (C_2H_5)_2O + H_2SO_4$. The distillate is freed from water by agitation with calcium oxide and chloride, and subjected to redistillation.

Properties.—A transparent, colorless, mobile liquid, having a characteristic odor and a burning and sweetish-taste. Spec. gr. .716 to .717 at 77° F. Soluble in about 10 times its volume of at 77° F. Miscible in all proportions with alcohol, chloroform, benzine, benzol, fixed and volatile oils. Ether boils at about 35.5° C. (96° F.), and it should therefore boil when a test tube, containing some broken glass and half filled with it, is held for some time in the hand. Ether is highly volatile and inflammable; its vapor, when mixed with air and ignited, explodes violently. The color of light blue litmus paper moistened with water should not be changed when the paper is immersed in ether for 10 minutes. Upon evaporation ether should leave no residue. Ether is a solvent for fats, oils, alkaloids, resins, gutta percha and gun cotton. Ether vapor is heavier than air, and, consequently, etherization should never be done above a light or fire.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ ii.-iv. (8.-15.); D., ♏x.-ʒi. (.6-4.).

PREPARATIONS.

Æther Purificatus. (B. P.)

(Ether freed from most of its alcohol and water.)

Spiritus Ætheris. Spirit of Ether. (U. S. & B. P.)

Ether, 325; alcohol, 675. (U. S. P.)
Dose.—Same as for ether.

Spiritus Ætheris Compositus. Compound Spirit of Ether. (U. S. & B. P.)

Synonym.—Hoffman's anodyne. Ether, 325; alcohol, 650; ethereal oil, 25. (U. S. P.)
Dose.—Same as for ether.

Action External.—Ether evaporates rapidly from the skin, and abstracts so much heat in the process that the superficial parts are cooled, benumbed, and even frozen. This action is taken advantage of in spraying ether from an atomizer upon the skin (with or without cocaine injected) to cause local anesthesia in minor surgical operations, as opening abcesses. The spray should not be applied more than a few minutes, or freezing, damage to the tissues, and retardation of the healing process will ensue. If ether is applied with friction, or if evaporation from the skin is prevented by bandaging, it will act as a rubefacient.

Action Internal.—Digestive Organs.—Ether is an irritant to

the mucous membrane of the digestive tract, and should be given only when considerably diluted with water. Ether stimulates secretion, motion, and increases local blood supply of the stomach. Ether, in concentration, resembles alcohol and ammonia in stimulating the heart reflexly, by its irritant action upon the alimentary canal, before it has time to be absorbed. It relieves pain and spasm in the digestive tract by coördinating or restoring nervous control over the stomach and bowels.

Circulation.—Ether is reflexly a stimulant to the heart and vasomotor centres through peripheral irritation of its vapor, as in the case of alcohol. Some authorities allow no direct stimulating action (Cushny). In poisonous doses, or after prolonged inhalation, the circulation becomes depressed and weak.

Nervous System.—Ether is chiefly depressant to nerve centres. Its apparent primary stimulation of the central nervous system is somewhat doubtful and many experimenters deny that it directly stimulates the nerve centres at all. Ether depresses and abolishes The functions of all the great nerve centres in the following order, and with the following results:

1. The cerebrum (with loss of consciousness).
2. Sensory spinal tract (loss of sensation).
3. Motor spinal area (loss of motion and partial loss of reflex action).
4. Sensory medullary centres.
5. Motor medullary centres (failure of respiration).

Ether does not affect the nerves or muscles when inhaled or ingested. Ether depresses the action of the nerves, however, when applied locally.

Respiration.—The respiratory centre is stimulated by inhalation or ingestion of therapeutic quantities of ether. Paralysis of the respiratory centre occurs in the last stage of ether poisoning. Ether vapor is irritant to the respiratory mucous membrane, and causes coughing and choking during inhalation. It is not an appropriate anesthetic, therefore, in inflammatory conditions of the respiratory tract, because its vapor is given in greater concentration than in chloroform. In giving ether by the drop method undue irritation of the lungs is avoided and such conditions as bronchitis, pulmonary edema and pneumonia. Ether vapor excites the peripheral ends of the trifacial nerve in the face, and the vagus nerve in the lungs, so the temporary arrest of respiration often occurs when a fresh supply of ether is added during inhalation.

Temperature.—The temperature of the body may be raised during the stage of excitement and struggling, but prolonged etheriza-

tion leads to loss of heat, owing to evaporation of ether from the lungs, and general depression of the nervous system.

Elimination.—Ether is eliminated principally from the lungs. Recent experiments indicate that ether causes contraction of the renal arteries, with diminution in the size of the kidneys, suppression of urine and albuminuria. Ether damages the kidneys, however, less than chloroform, which sometimes leads to fatty degeneration.

Acetone has been found in the urine of 90% of patients in human practice within 18 hours of etherization (through a closed cone). Death may sometimes occur in coma, following ether anesthesia, with rapid pulse and breathing and the odor of acetone in the breath. This occurs less often than with chloroform (which see, under Metabolism).

Uses.—Apart from its value as an anesthetic, ether is mainly of service for two purposes. First: in collapse, syncope, or "sinking spells," due to poisoning, or natural causes. Ether may be given by the mouth, or subcutaneously into the muscular tissue, to avoid abscess. It should not be given as a stimulant when such an agent is required during or following anesthesia. Second: In spasmodic colic or tympanites, ether relieves pain, spasm and flatulence. The following prescription will be found useful for the horse:

℞

Ætheris	℥ i.
Chloroformi	ʒ ii.
Tinc. opii	℥ ii.

M. et f. haustus.

S. Give at once in a pint of cold water.

Ether is a good antispasmodic remedy for asthma, hiccough or "thumps," in the horse, and has a narcotic action upon tape and lumbricoid worms. When used for the latter purpose, ether should be followed by a purge. Ether may be employed in an enema to narcotize and remove the Oxyuris curvula of the horse. Ether should never be given internally or by inhalation to animals whose flesh is to be eaten soon after as it imparts a strong flavor to the meat and is also said to "spot" it.

Administration.—Ether should be given in gelatine capsules; mixed with two parts of cracked ice and water; or with equal parts of brandy or whisky, to avoid undue irritation by ether and its vapor upon the mucous membranes during deglutition.

CHLOROFORM. Chloroform. C H Cl_3. (U. S. & B. P.)

Synonym.—Chloroformum purificatum, purified chloroform, E.; chloroformium, P. G.; formylum trichloratum, chloroforme pur, Fr.; reines chloroformum, G.

A liquid consisting of 99 to 99.4 per cent., by weight, of absolute chloroform, and 0.6 to 1 per cent. of alcohol.

Derivation.—Alcohol and water are heated in a still to 37.7° C. (100° F.), when chlorinated lime is added and chloroform is evolved. The chemical action is very complicated. Chloroform, free from chlorinated compounds, is also made from acetone and chlorinated lime by distillation. Calcium acetate, hydrate and chloride result as bye products.

$2\ C_3H_6O + 6\ Ca\ O\ Cl_2 = 2\ C\ H\ Cl_3 + Ca\ (C_2H_3O_2)_2 + 2\ Ca\ O_2H_2 + 3\ Ca\ Cl_2$.

For tests and purification, *vid.* U. S. P.

Properties.—A heavy, clear, colorless, mobile and diffusible liquid, of a characteristic, ethereal odor, and a burning, sweet taste. Spec. gr. not below 1.476 at 25° C. (77° F.). Soluble in about 200 times its volume of cold water, and in all proportions in alcohol, ether, benzol, benzine and the fixed and volatile oils. Chloroform is volatile even at a low temperature, and boils at 60° to 61° C. (140° to 141.8° F.). It is not inflammable, but its vapor in the presence of a naked flame undergoes decomposition with the formation of noxious gases, chiefly chlorine. This has caused death during chloroform inhalations. Chloroform is a solvent for fats, resins, oils, balsams, gutta percha, wax and many alkaloids.

Dose.—H. & C., ℥ i.-ii. (4.-8.); Sh. and Sw., ♏ xx.-xxx. (1.3-2.); D., ♏ ii.-xx. (.12-1.3).

PREPARATIONS.

Aqua Chloroformi. (U. S. & B. P.)

(Saturated Solution.)

Used as vehicle in cough and diarrhea mixtures for dogs.

Linimentum Chloroformi. (U. S. & B. P.)

Chloroform, 300; soap liniment, 700. (U. S. P.)

Spiritus Chloroformi. (U. S. & B. P.)

Chloroform, 60; alcohol, 940. (U. S. P.)

Dose.—H. & C., ℥ i.-ii. (30.-60.); Sh. & Sw., ʒ ii.-iv. (8.-15.); D., ʒ ss.i. (2-4.).

Action External.—Chloroform acts as a rubefacient if rubbed into the skin, or prevented from evaporation by bandaging. In evaporating from the surface it produces mild refrigeration. Chloroform penetrates the skin more easily than many other agents, and is employed for this reason to aid the absorption of belladonna and other drugs used in liniments. Chloroform possesses some local anesthetic action upon mucous membranes, raw surfaces, or when rubbed into the skin.

Action Internal.—Digestive Tract.—Chloroform is an irritant in concentration, but, properly diluted, stimulates the flow of saliva and increases the secretions, motion, and blood supply of the stomach. Chloroform has a local anesthetic and antiseptic action in the alimentary canal, and by its stimulant effect in restoring the normal state of nervous and muscular tissue, relieves spasm, pain and flatulence in the stomach and small intestines.

Circulation.—Chloroform exerts an ever increasing depressing influence upon the heart muscle, its ganglia, and the vasomotor centres.

Vasomotor depression leads to dilatation of the arterioles and leaking of blood into the veins, with consequent venous engorgement (particularly of the abdomen), and arterial anemia. Failure of respiration in chloroformization is secondary to cerebral anemia, and chloroform kills, primarily by vasomotor depression. (Leonard Hill and Hare.)

The ventricles dilate and all cardiac muscular contractility is lost in fatal poisoning. Death, however, occurs almost invariably in healthy animals during chloroform inhalation from respiratory failure associated with circulatory depression. The heart usually continues to beat after cessation of breathing. Death from syncope occurs occasionally, and circulatory depression is greater and occurs more suddenly than with ether. Rarely sudden death occurs in the beginning of anesthesia from reflex inhibitory arrest of the heart produced by the inhalation of concentrated chloroform vapor. The degree of concentration is of the utmost importance. A great deal of chloroform may be given for a long period if it is greatly diluted with air. It is not the amount but the rapid absorption of concentrated vapor which kills.

With ether the vapor may be greatly concentrated without danger; with chloroform the difference between the necessary concentration for anesthesia and that which means danger is slight. As chloroform anesthesia proceeds, the pulse becomes rapid from the depressing effect of chloroform upon the vagus centre.

Respiration.—Chloroform does not markedly affect the respiration, when inhaled in proper dilution for an ordinary period, or

when ingested in small doses, but after long continued inhalation, or when large quantities have been swallowed, depression and paralysis of the respiratory centre ensues. Since asphyxia leads to inhibition and heart failure—besides being dangerous in itself—the respiration should always be watched as carefully during chloroform as in ether inhalation.

Nervous System.—Chloroform depresses the nervous system as described under ether; that is, the cerebrum, sensory and motor spinal tract, and sensory and motor centres of the medulla. Chloroform, although generally following the order noted, affects the nervous system more rapidly, irregularly and persistently than ether, and therefore is more dangerous. It occasionally happens that some of the reflexes are abolished by chloroform before sensation has been annulled, and irritation of a sensory nerve produced during operation may reflexly stimulate the inhibitory centres (instead of increasing vascular tension as in health), and so cause heart failure. Operations should never be performed, therefore, under chloroform until complete anesthesia is secured. The nerves are not influenced by the constitutional action of chloroform, although the latter is a local irritant and anesthetic to them.

Temperature.—The temperature is reduced by the continual inhalation of chloroform through its depressing action on the heat producing centres, and because heat loss is increased by evaporation of chloroform from the lungs.

Antiseptic Action.—Chloroform prevents the growth of microorganisms, but does not influence that of the unorganized digestive ferments. Chloroform's antiseptic properties may be utilized in preserving solutions for subcutaneous injection. Saturated aqueous solutions are used for this purpose.

Metabolism.—Death occasionally follows chloroformization from fatty degeneration of the heart, liver and kidneys. Chloroform apparently leads to imperfect oxidation of nitrogenous bodies and to production of acid in the tissues with the formation of acetone which is eliminated in the breath and urine. Death occurs in coma in acetone poisoning from chloroform, as happens in diabetes mellitus.

Elimination.—Chloroform is chiefly eliminated by the lungs and slightly by the kidneys, but is also decomposed in part in the body.

Uses External.—Chloroform is employed in liniment to relieve pain and produce counter-irritation in muscular rheumatism and strains.

Uses Internal.—Chloroform is of service internally in the treatment of four conditions: 1. Intestinal colic, and flatulence. 2.

Spasm, as in spasm of the diaphragm in horses. 3. Diarrhea. 4. Cough. Chloroform alleviates pain in colic by restoring the functions of the nervous and muscular mechanism of the bowels, by relieving spasm, and also by its local anesthetic action. It stimulates motion and secretion; it is an antiseptic in the digestive tract, and, in these ways, overcomes flatulence.

Chloroform should be combined with opium in diarrhea and colic. It is administered in spirit or water to assuage cough.

Administration.—Chloroform may be administered in 3 parts of glycerin; in emulsion with white of egg or accacia; or as the spirit, diluted with water.

ANESTHESIA.

Anesthesia is commonly divided into three stages: the stimulant, anesthetic and paralytic. The so-called "law of dissolution" is illustrated by anesthetics, as the more highly organized (cerebral) centres are the first to succumb, while the lower centres (medulla) are the last to be affected. The anesthetics resemble other narcotics in producing a primary condition of stimulation of the nervous system, which is followed by depression. In the first stage of anesthesia there is often struggling and excitement. This may partly be due to the physiological action of the drug but chiefly to local irritation and fright. In this stage the functions of the brain are stimulated and then depressed. The higher functions are the first to be excited, and the effect produced is very similar to that of beginning alcoholic intoxication. The lower motor functions are next stimulated, inducing struggling and motor excitement.* In the first stage of etherization, the local irritant action of the vapor causes choking and coughing, and also induces struggling. The respiratory and cardiac centres are temporarily stimulated, the pulse and respiratory movements are increased in force and frequency, and blood tension is raised. The smaller animals may vomit during the first stage of anesthesia. A subdivision of the first stage, sometimes described as the anodyne stage, occurs when sensation is lost, before consciousness and voluntary motion. Short operations, as extraction of teeth, have been done by men upon themselves in the anodyne stage of anesthesia, without pain. The anesthetic stage is that condition characterized by absence of consciousness, sensation, motion,

* As recent researches show ether, like alcohol, to be depressing to nerve centres from the outset it is probable that the excitement in anesthesia is due to the local irritation of the throat and fright.

With the drop method of etherization in man there is little or no struggling and excitement.

and partial loss of reflex action, and is that state suitable for operations. The stimulating action of the anesthetic has ceased and there is now depression of the cerebral functions, the motor and sensory tract of the cord, and, to a partial extent, the reflex centres. The muscles are completely relaxed, and the patient lies absolutely motionless. The conjunctivæ fail to respond to irritation, *i.e.*, winking is not produced when the conjunctival membrane is lightly touched with the finger. Occasionally the muscles are seen to be rigid and twitching during this stage of etherization, although sensation and consciousness are absent. The respiration and pulse should not be particularly altered during the anesthetic stage, unless danger threatens. In the last stage, narcosis, or poisoning, is beginning, and there is depression of the three great medullary centres controlling the heart, respiration and vascular tension, and also the lowest reflex centres of the cord, so that the urine and feces are passed involuntarily. Micturition frequently occurs in the first stages of anesthesia and should not of itself be considered a danger signal. The pulse becomes rapid, feeble and irregular; the breathing is at first stertorous, and then the respiratory movements become shallow and weak, with considerable intervals intervening between them. The pupils are often dilated. The pupil is said to be a guide during anesthesia, especially with chloroform, since it is contracted during the anesthetic stage and dilates quickly when danger approaches. Death, however, occurs in animals with either dilated or contracted pupils. With the former, probably from asphyxia; with the latter, from syncope; and the pupil should not be regarded as an unfailing sign. The foregoing stages are conventional, and are not in any case so clearly defined in practice as they are described theoretically upon paper. The first stage may be either absent or prolonged, and the last stage should not be reached at all.

COMPARISON OF ETHER WITH CHLOROFORM.

ETHER.	CHLOROFORM.
More diffusible.	Vapor heavier.
Inflammable.	Non-inflammable.
Irritating, may induce bronchitis, pulmonary edema and pneumonia, unless properly diluted (see drop method, p. 282).	Non-irritating.
Reflexly stimulant to heart and vasomotor centres and does not so easily depress the respiratory centres.	Depresses powerfully the heart, respiratory and vasomotor centres, in large doses.
Larger quantity required.	Drams of chloroform do the work of ounces of ether.

More expensive.	Cheaper.
Less rapid.	Acts more quickly; profoundly and persistently.
Fatal from respiratory failure and acapnia (see p. 278).	Fatal from respiratory failure combined with circulatory depression and vasomotor paralysis, or later from fatty degeneration of the internal organs, or from acetone poisoning. Occasionally fatality results from reflex inhibitory arrest of the heart.

The mortality is 1 in 3,162 chloroformizations; and 1 in 16,302 etherizations in over a million cases in human practice (Hewitt). Chloroform is 3½ times more depressant to nerve centres, 8 times more depressant to the heart, and causes 5 times more deaths, than ether.

It will be seen that all the advantages are in favor of chloroform, except that of safety. "Ether is more expensive than chloroform, but cheaper than a funeral." (Edes.)

ACCIDENTS AND DANGERS ATTENDING ANESTHESIA.

Respiratory failure and asphyxia may occur from giving too much of the anesthetic and from mechanical obstruction in the air passages. The tongue may fall back upon the epiglottis and prevent the free entrance of air. The latter accident is obviated by pulling the tongue forward with the hand, or, in the case of the smaller animals, by means of forceps, or suture passed through the tongue. Mucus, blood or vomitus may obstruct the mouth, pharynx, larynx, or trachea, and should be removed if possible by swabbing with absorbent cotton. To prevent excessive secretion of mucus in the air passages atropine may be given subcutaneously fifteen minutes before etherization. The head should be extended and the lower jaw of the patient held forward during anesthesia, and no impediment to the free movement of the chest is allowable. Struggling is to be avoided, as far as possible, since it leads to irregular respiration and asphyxia, and causes the anesthetizer to push the inhalation; strains the heart, and favors cardiac dilatation with chloroform. Struggling may be prevented to some extent by giving the anesthetic well diluted with air at the outset. Asphyxia results also from tetanic fixation, or relaxation of the respiratory muscles. The signs of asphyxia include cyanotic mucous membranes, muscular twitchings, shallow, feeble, slow and irregular breathing, with long intervals between the respiratory movements, and dilation of the pupils. If

death occurs, the heart continues to beat after the breathing stops. The condition of the diaphragm during etherization is an important guide. At first the contractions of the diaphragm are so vigorous that the viscera are forced backward, and the abdominal wall bulges outward during inspiration. As the inhalation is prolonged the diaphragm becomes flaccid and powerless, the respiratory movements are shallow, and the breathing thoracic. The abdominal contents may then be drawn forward during inspiration into the thoracic cavity, so that the abdomen is retracted (Hare). When the latter condition is seen, etherization should be stopped instantly.

Heart failure occurs more frequently with chloroform, but does occasionally result from the action of ether upon animals with a fatty or otherwise weak heart. Cardiac depression is shown by a weak, irregular and rapid pulse, and pallor of the mucous membranes. Respiration begins to fail before the heart stops in chloroform. Artificial respiration will therefore usually prevent death. The real cause of death is, however, vasomotor paralysis in chloroformization. Operations should never be done under chloroform before the patient is fully under the influence of the anesthetic, as irritation of a sensory nerve caused by even a slight surgical procedure may cause death by reflexly stimulating the vagus and inhibiting the heart. Such an accident is not likely to occur with ether, and minor operations are often done with safety during the first stage of anesthesia (primary anesthesia) when consciousness and sensation are lost and the muscles begin to relax.

Shock from hemorrhage, or prolonged and severe surgical operations, may lead to fatalities during anesthesia, and it sometimes occurs when an operation is begun before the patient is fully under the influence of an anesthetic—particularly chloroform—as described above. The latest and at present accredited explanation of shock and failure of respiration in surgery is as follows: Shock and respiratory failure result from pain or irritation of sensory nerves under general anesthesia, and to the action of anesthetics. Pain produces deep breathing, accumulation of oxygen in the blood (hyperpnea) with proportionate diminution of CO_2 in the blood (acapnia).

CO_2 is *the* excitant of respiration. Anesthesia lessens the susceptibility of the respiratory centre to the stimulating action of CO_2. If deep breathing continues, owing to the effects of irritation of beginning anesthesia or to sudden or continuous irritation of sensory nerves, respiration may stop from diminution of CO_2. Or shock with venous stagnation may ensue from lack of CO_2, because the tonicity of the veins and the tissues depends upon a proper amount of CO_2 in the blood. In practice, three causes of danger, *i.e.*, res-

piratory failure, circulatory depression and shock, are usually combined.

Where important nerve trunks are to be divided shock is diminished by injecting them with cocaine solution before their division, this is called "blocking" them.

The following embraces the proper treatment of all these conditions, and should be followed in every case where danger threatens during anesthesia:

1. Remove the anesthetic and allow plenty of fresh air.

2. See that there is no mechanical obstruction to the movements of the chest, or to the free entrance of air. Pull forward the tongue and lower jaw and extend the head.

3. Invert small animals, particularly with chloroform, to allow blood to flow to the brain.

4. Use forced, artificial respiration with bellows and rubber tube introduced into larynx. Practice ordinary artificial respiration in small animals by carrying the forelegs outward and forward till they meet in front of the head, and then bring them back till they touch, and compress the sides of the chest. These movements should be repeated twenty times a minute. Massage over the heart, together with artificial respiration, is useful in sudden cardiac arrest in small animals. Artificial respiration may be done in the horse by two persons compressing intermittently one side of the chest with the knees and hands. Rhythmical traction of the tongue, at intervals of five seconds, has proved successful in restoring respiration. Dash hot or cold water or ether upon the chest or epigastrium; or use the faradic battery to stimulate respiration by moving the electrodes over the chest and abdomen. Stretch the sphincter ani apart by placing the thumbs in rectum and separating them with force. This is a powerful reflex stimulus to heart and respiration.

5. Give subcutaneous injections of strychnine and digitalone. In chloroformization, give strychnine and atropine hypodermatically; and, in shock, saline infusion with adrenalin, as below. Do not use alcohol or ether as stimulants, for their action resembles that of the anesthetics.

6. Use hot (115° F.), high, rectal injections of salt solution (one heaping teaspoonful to the quart) in case of surgical shock with feeble pulse and subnormal temperature resulting from hemorrhage or other cause. Two to four gallons for large animals, and one pint to one quart for smaller animals. Saline infusion is still more efficient. (See "Saline Infusion," p. 655.)

CHOICE OF AN ANESTHETIC.

Ether and chloroform are the only anesthetics of any importance in veterinary medicine. The A. C. E. mixture, containing alcohol (one part), chloroform (two parts), and ether (three parts), possesses no particular value, and is not so safe as ether. While chloroform is inferior to ether in the matter of safety, it may be given to horses by an experienced and careful person without much danger. It is commonly the most suitable anesthetic for the horse, for the following reasons: It is less expensive; whereas several pounds of costly ether are required to produce anesthesia, a few ounces of chloroform will accomplish the same result. Chloroform inhalation is much easier of administration, more rapid, and causes less struggling. It may be used without any special inhaler, and may be given to animals in the upright position. It should not be given if fatty heart is suspected.

Chloroform may be employed for all animals during parturition, as it is less dangerous in this condition and because only enough is needed to produce relaxation of parts to relieve pain, to assist dilatation of the os and manual operations done to rectify faulty position of the fetus.

Chloroform is indicated in all cases where the actual cautery is used in the neighborhood of the mouth. Ether is the most suitable anesthetic for cats and dogs, unless the animal is suffering from bronchitis, emphysema or asthma, when chloroform is more appropriate. Chloroform, being more rapid and less irritating, may in any case be employed to begin anesthesia, which should then be maintained by ether. The use of anesthetics is contraindicated in anemia if the hemoglobin is reduced below 30 per cent.

PRACTICAL ANESTHESIA.

The horse should be starved for twelve hours, and should receive a cathartic twenty-four hours before anesthetization, in order to afford more room for the respiratory movements and prevent accidents in casting. A specially constructed inhaler, or nose bag, strapped about the head, may be employed for convenience. Hypodermic injection of morphine (gr. iii.) thirty minutes before anesthesia is often of advantage. It diminishes excitement and allows of the use of a smaller amount of the anesthetic. It is very important that all preliminary procedures should be done—as casting, preparation of the operative field, etc.—before the chloroform is begun, to lessen the necessary amount of the anesthetic. A drachm or two of chloro-

form may be placed on each sponge as an initial dose, to hasten the anesthesia, while after this the method of constant dropping is to be preferred. Harger recommends placing a sponge wrapped loosely in flannel, in the upper nostril, as the animal lies upon his side upon the ground, and after a few minutes a similar sponge is introduced into the lower nostril.

Chloroform is then administered in continuous drop doses from a bottle having a cork nicked upon the side sufficiently to allow the anesthetic to flow out in this small quantity. The nostrils should be previously smeared with vaseline to afford protection from the irritation of the chloroform. If the operation is prolonged, anesthesia may be carried on with ether. It is not essential to cast a horse before chloroformization, but the animal should be controlled with side lines, and a twitch should be placed upon the nose, unless an inhaler is used. Since there is commonly more or less struggling, it is, however, more satisfactory to cast an animal before anesthesia is begun. The writer has given chloroform in several instances to horses in the standing position until they fell or were pushed over upon a straw bed, with the aid of only one assistant. In thus producing anesthesia, a sponge covered with a towel was used, and this was saturated with about half an ounce of chloroform, and held at first three inches from the animal's nose, in order that the vapor should be thoroughly diluted with air. From half a drachm to a drachm of chloroform should be added from time to time, always allowing plenty of air, and inhalation may be continued by the drop method for an hour with comparative safety.

The anesthetizer should give his whole attention to the work, and watch carefully the respiration, pulse and pupil, for any sign of danger. If any arise, the anesthetic should be removed and treatment pursued as recommended in the previous section.

Dogs should be fasted for twelve hours before etherization, in order to avoid vomiting during anesthesia. From ½ to 2 grains of morphine, according to the size of the patient, should be given subcutaneously 30 minutes before ether is administered. It is necessary to muzzle dogs before anesthesia is begun. This may be done by tying a strong tape about the nose, bringing both ends up between the ears, over the top of the head, and then tying them together in a knot, and finally carrying the ends down, one on either side of the neck, and fastening them underneath. A wire muzzle may be used to control the dog more conveniently, and the ether is then poured upon a sponge within the muzzle and the muzzle is covered with cloth to keep out the air. More recently the writer has found the following method and appliance most suitable for dogs and small animals. A cone of leather open at both ends and tapering to fit

the muzzle is slipped on to the nose and up to the base of the ears. This is held in place by a strap sewed to one side of the large end of the cone and buckled to the other side. The strap passes over the top of the head behind the ears and the cone is thus held in place automatically and acts as a muzzle as well. The small end of the cone is long and projects beyond the tip of the nose and into this is stuffed gauze or a sponge for ether. Ether is given by the drop method. That is, a wedge-shaped piece is cut from the cork of the ether bottle or can, and a little piece of gauze is laid in this, which acts like a wick and allows a continual dropping when the bottle is inverted. This is the safest method and requires the least ether.

Dogs may also be anesthetized by placing them in a covered pail, tight box or barrel, or by driving them into their kennels, and dropping in cloths, sponges, or absorbent material saturated with chloroform, while excluding the outer air. The smaller animals can be destroyed in a humane and satisfactory manner by this method.

USES OF ANESTHESIA.

Anesthetics are not employed as frequently as they should be in veterinary medicine. Anesthesia entails skilled assistance, increased expense, and danger; but, on the other hand, facilitates rapidity and asepsis during operations by lessening struggling, and should be employed to relieve suffering where a local anesthetic is impracticable. The owner of an animal should be made to understand the extra risk and expense attending operations under anesthesia, and his consent should be secured before using ether or chloroform.

The general indications for anesthetics embrace all severe, prolonged, and delicate operations. The more special indications are as follows: In abdominal operations, as ovariotomy, herniotomy and reduction of hernia. In operations for retained testicle, scirrhus cord, castration, and in dystocia to cause dilatation of a rigid and otherwise undilatable os, to assist the operator in remedying faulty positions of the fetus by relaxation of the parts, and to facilitate instrumental delivery in bitches. Anesthesia is also indicated in removal of tumors, excision of the eyeball or parts of the hoof, extraction of teeth, reduction of dislocations, setting of fractures, and to relieve severe pain in colic, and to overcome spasm in chorea and hiccough, or convulsions due to poison or natural causes.

Chloroform is used to destroy sick, injured or aged horses, but is not so rapid, convenient, or effective as the 44 calibre revolver, or rifle. The bullet should be directed toward a point upon the fore-

head at the intersection of two imaginary lines drawn from either eye up to the root of the opposite ear.

Class 3.—Nitrites.

Spiritus Ætheris Nitrosi. Spirit of Nitrous Ether. (U. S. & B. P.)

Synonym.—Sweet spirit of nitre, spiritus nitri dulcis, spiritus nitrico-ethereus, E.; éther azoteux alcoolisé, liqueur anodine nitreuse, Fr.; versüsster salpetergeist, G.

An alcoholic solution of ethyl nitrite ($C_2H_5NO_2$), yielding, when freshly prepared, not less than 4 per cent. of ethyl nitrite.

Derivation.—Mix sulphuric acid (40 c.c.) with water (120 c.c.), cool and add alcohol and water (each, 85 c.c.) and place in 1000 c.c. flask surrounded by ice and water. Dissolve sodium nitrite (100 gm.) in water (285 c.c.), filter and allow filtrate to drop slowly into the flask above. Wash ethyl nitrite formed with sodium carbonate solution, to remove acid, and agitate with potassium carbonate, to remove water. Add ethylnitrite to 22 times its weight of alcohol.

Properties.—A clear, mobile, volatile, inflammable liquid, of a pale-yellowish or faintly greenish-yellow tint, having a fragrant ethereal and pungent odor, free from acidity, and a sharp burning taste. Spec. gr. 0.823. Mixes freely with water and alcohol.

Dose.—H. and C., ʒ i.-iv. (30.-120.); Sh. and Sw., 3 ii.-iv. (8.-15.); D., ♏x.-3 i. (.6-4.).

Smaller doses every two hours, diaphoretic. Larger doses, repeated three times daily, diuretic.

Amylis Nitris. Amyl Nitrite. $C_5H_{11}NO_2$. (U. S. P.)

Synonym.—Amyl nitris, B.P.; amylum nitrosum amylether nitrosus, amylo-nitrous ether, E.; azotite d'amyl, Fr.; amylnitrit, G.

A liquid containing about 80 per cent. of amyl (principally iso-amyl) nitrite, together with variable quantities of undetermined compounds.

Derivation.—Obtained through distillation of nitric acid and amylic alcohol. Distillate purified by sodium carbonate. $HNO_2 + C_5H_{11}OH = C_5H_{11}NO_2 + 2\ H_2O$.

Properties.—A clear, yellow or pale-yellow liquid, of a peculiar ethereal, fruity (banana) odor, and a pungent, aromatic taste. Spec. gr. 0.865 to 0.875.

Dose (by inhalation).—H., 3 ss.-i. (2.-4.); D., ♏ii.-v. (.12-.3).

When given internally the smaller doses should be used dissolved in alcohol.

SPIRITUS GLYCERYLIS NITRATIS. Spirit of Glyceryl Trinitrate, Spirit of Glonoin. $C_3H_5 (N O_3)_3$. (U. S. P.)

Synonym.—Liquor trinitrini, B.P.; spiritus glonoini, propenyltrinitrate, glonoin trinitrate, spirit of nitroglycerin, trinitrate of glyceryl, trinitin, E.

An alcoholic solution containing one per cent., by weight, of nitroglycerin. It is probably decomposed in the blood with the formation of potassium and sodium nitrite.

Derivation.—Nitroglycerin is obtained by dropping pure glycerin upon a mixture of sulphuric and nitric acids, kept cool by ice, and purified by washing with water. The official one per cent. solution is not explosive unless it becomes concentrated by evaporation to an extent exceeding 10 per cent.

Properties.—A clear, colorless liquid, possessing the odor and taste of alcohol. Caution should be exercised in tasting it, since even a small quantity is liable to produce a violent headache. Spec. gr. .814 to .820.

Dose.—H., 3 ss.-i. (2.-4.); D., ♏i.-ii. (.06-.12).

ACTION OF THE NITRITES.

External.—Spirit of nitrous ether, like ether, produces a cooling and local anesthetic action, owing to its evaporation upon the skin. Amyl nitrite has a slight depressing action upon the peripheral ends of the sensory nerves.

Internal.—The actions of spirit of nitrous ether, amyl nitrite and nitroglycerin are essentially the same. Spirit of nitrous ether should contain 4 per cent. of ethyl nitrite. Analysis of 68 samples taken at random from drug stores, resulted in showing that a teaspoonful of the best specimen contained as much ethyl nitrite as a pint of the worst, with all manner of variations between these extremes. To be of value as a nitrite, sweet spirit of nitre should be freshly prepared by a reliable chemist.

Circulation.—The important action of the nitrites centres upon the heart and blood-vessels. The arteries and veins all over the body (but particularly of the head and belly) become relaxed and blood tension is lowered by the nitrites. This action is no doubt peripheral, and is due to direct depression of the unstriated muscle of the vessel walls. The heart beats more rapidly in consequence of the lessened

vascular resistance and direct depression of the inhibitory centre and because a diminished blood pressure indirectly depresses the vagus centre and often stimulates the accelerator. The arterioles being dilated in the heart, as elsewhere, there follows an increased cardiac blood supply, nutrition and force. It is probable that the nitrites slightly increase the force as well as the rapidity of the heart. This is shown by the fact that in small doses blood pressure is raised by the nitrites, despite the vascular dilatation. However, the nitrites, as nitroglycerin, are not of practical value as heart stimulants in poisoning (anesthetics) or emergencies, particularly where the vasomotor tone is depressed. The stimulant action on the heart has been much overrated and is practically nil. Poisonous doses depress the heart muscle and the pulse becomes slow and weak.

Nervous System.—The nitrites depress the spinal motor centres. This is more marked in the frog than mammals, however. Neither the motor nor sensory nerves nor cerebrum appear to be influenced by medicinal doses of nitrites. Reflex excitability is lessened.

Muscles.—Amyl nitrite paralyzes both unstriated and striated muscular tissue when applied locally; and the nitrites, when administered internally, relieve spasm of muscular tissue by their depressing action upon the motor nerves and muscles.

Kidneys.—Nitrites often increase the flow of urine by widening the renal arteries supplying the glomerules. But the general lowering of blood pressure may prevent an increase of local pressure in the kidney, when urinary secretion will be diminished.

Blood.—In poisoning by the nitrites, the oxidizing power of the blood is lost. Both the venous and arterial blood become of a chocolate hue from the conversion of the normal oxy-hemoglobin into meth-hemoglobin. The latter yields up oxygen very sparingly.

Respiration.—The respiratory movements may be increased both in force and frequency by medicinal doses of nitrites, but paralysis of the respiratory centre and asphyxia occurs in fatal poisoning.

Elimination.—The nitrite group rapidly escape in the urine as nitrites and nitrates of the alkalies. The amyl, of amyl nitrite, is completely oxidized in the body, while nitroglycerin is eliminated in part unchanged in the urine.

Summary.—The nitrites dilate arterioles, increase the rate of the heart-beat, depress the spinal motor area, and lessen reflex action. They relieve spasm and may increase the secretion of urine.

Poisoning.—Fatal poisoning is extremely rare as an accidental occurrence. Recovery from a quantity 120 times greater than the normal dose of nitroglycerin, has been reported in human practice. The physiological effects of the nitrites are more noticeable in man, owing to his bare skin. Immediately following the inhalation of

amyl nitrite, the face becomes extremely flushed, and throbbing of the vessels of the head, with a feeling of tremendous pressure and headache, ensue. These symptoms are due to vascular dilatation. There is dizziness, the heart is rapid and violent, and the pulse full, frequent and easily compressible. The respiratory movements are increased. These symptoms occur after a full medicinal dose.

In poisoning there is pallor, vomiting in man, trembling, weakness, cyanosis and failure of respiration and heart. The treatment is included in the administration of ammoniacal and alcoholic stimulants, together with the subcutaneous injection of ergotin, strychnine and atropine, to restore the vascular tone.

The nitrites differ sufficiently to call for a word concerning their individual characteristics. It is important to emphasize the fact that their action, as a whole, is transient. Amyl nitrite diminishes vascular tension, as shown by the sphygmograph, within a minute of its inhalation, and this condition lasts for 2 to 4 minutes, with variations of from 10 to 30 minutes. The same action of nitroglycerin occurs within 6 minutes and lasts from half to, rarely, an hour and a half.

Good spirit of nitrous ether lowers tension from 45 to 60 minutes. In addition to this difference in degree, spirit of nitrous ether differs somewhat in kind of action. It is more stimulant to the heart, and more diuretic, owing to the ether it contains. For the same reason sweet spirit of nitre increases the secretions and motion of the upper part of the digestive tract, relieves spasm and is of some value in indigestion and mild colic. In stimulating the activity of the sweat glands, following its action in dilating peripheral vessels, sweet spirit of nitre is a useful diaphoretic and mild febrifuge.

It has been pointed out that spiritus etheris nitrosi is far from being a reliable preparation as a nitrite, and therefore nitroglycerin or amyl nitrite are preferable where rapid and certain vascular dilatation is essential.

USES OF THE NITRITES.

Internal.—Respiratory Diseases.—No drug is more efficient than spirit of nitrous ether, in the treatment of acute diseases of the respiratory tract, as coryza, pharyngitis, laryngitis and bronchitis. Its value lies in its power of dilating peripheral vessels, equalizing the circulation and preventing local congestions.

In assisting diaphoresis and diuresis, sweet spirit of nitre hastens elimination of toxins and cools the body; and in both ways is useful in abating fever. The following prescription may be of service in canine practice in febrile conditions:

℞

Tinc. aconiti	ʒ iii.
Spiritus ætheris nitrosi	ʒ vi.
Potassii bromidi	℥ ss.
Liq. Ammonii acetatis ad	℥ iv.

M.

Sig. Teaspoonful in water every 2 hours.

In asthenic and febrile diseases, as influenza, sweet spirit of nitre is of worth, combined with tonic doses of quinine and alcoholic stimulants. In catarrhal troubles and distemper of dogs it is conjoined with spirit of camphor. In colic of horses it is prescribed with laudanum.

The nitrites are the most successful remedies in relieving dyspnea, when due to spasm of the bronchial tubes, or congestion of the lungs. They relax the bronchioles and avert congestion by vascular dilatation and equalization of the circulation. Thus the dyspnea occurring in pneumonia, acute pulmonary edema, asthma and chronic bronchitis, are advantageously treated by half-hourly or hourly doses of nitroglycerin. Amyl nitrite, in dilating peripheral vessels and blanching the lungs, has proved one of the most successful remedies in hemoptysis.

Cardiac Diseases.—These are comparatively rare in the lower animals; but, in general, it may be said that no remedy is more useful for its transient action in the severe dyspnea of cardiac diseases than nitroglycerin. The passing engorgement of the right heart and lungs is relieved by nitroglycerin, which tends to distribute the blood about the body in its proper channels, and thus take the load off the heart temporarily.

Nervous Diseases.—Nitrite of amyl is invaluable in warding off epileptic seizures in man, when warning of their approach is given the patient. As this warning cannot be detected in the lower animals, the nitrites are of less value, but may be combined with the bromides as prophylactic agents. The nitrites exert their favorable effect in this condition by preventing cerebral vasomotor spasm, which is thought to occur in epilepsy. Amyl nitrite is useful in relieving hiccough or "thumps" in horses and in strychnine poisoning.

Diseases of Urinary Organs.—Spirit of nitrous ether is useful as a diuretic in carnivora, when the urine is concentrated and irritating to the bladder. It is also a valuable remedy, for the same reason, in acute cystitis of all animals, when it may be combined to advantage with potassium citrate, or acetate and tincture of aconite.

Summary.—We may summarize the therapeutical indications for the nitrites as follows:

1. To dilate peripheral arterioles and equalize the circulation in internal congestions.

2. To relieve spasm of vascular, nervous, or muscular origin.

3. To increase the secretion of urine.

Administration.—Sweet spirit of nitre is given by the mouth, diluted with water, and often combined with alcoholic stimulants (whisky), diaphoretics (liq. ammon. acetatis), diuretics (potassium nitrate), and bitters (quinine).

Amyl nitrite is administered usually by inhalation to the larger animals, from a sponge; or two or three drops are given by inhalation from a bit of linen or cotton to the smaller animals. It may be given internally on sugar to the smaller animals, or in spirit to the larger patients. The spiritus glonoini is the only preparation of nitroglycerin in use. It may be dropped undiluted upon the tongue of the conscious or unconscious animal. The tongue of the smaller animals may be frequently moistened with a small stick dipped in the solution, or it may be given in pill or tablet.

Class 4.—Chloral.

CHLORALUM HYDRATUM. (U. S. P.)

CHLORAL HYDRATE. Chloral. ($C_2H\ Cl_3O + H_2O$.)

Snyonym.—Chloral hydras, B. P.; hydrate of chloral, E.; chloratum hydratum crystallisatum, P. G.; hydrate de chloral, Fr.; chloralhydrat, G.

A crystalline solid, composed of trichloraldehyde, or chloral with one molecule of water.

Derivation.—Dry chlorine gas is passed into absolute alcohol until the latter is saturated. Aldehyde and hydrochloric acid first result, $C_2H_5O\ H + 2\ Cl = C_2H_4O + 2\ H\ Cl$. The chlorine gas then acts upon the aldehyde, abstracting 3 atoms of hydrogen and replacing 3 atoms of chlorine, and so forms chloral. $C_2H_4O + 6\ Cl = C_2H\ Cl_3\ O + 3\ H\ Cl$.

Chloral is purified first by distillation with sulphuric acid, and then with lime, and when mixed with water forms chloral hydrate ($C_2H\ Cl_3O + H_2O$).

Properties.—Separate, rhomboidal, colorless and transparent crystals, having an aromatic, penetrating and slightly acrid odor, and a bitterish, caustic taste. Slowly volatilized when exposed to the air. Freely soluble in water, alcohol or ether; also in chloroform, benzol, benzin, carbon disulphide, fixed and volatile oils. It liquifies when triturated with about an equal quantity of camphor, menthol, thymol

or carbolic acid. Chloral is decomposed by caustic alkalies, alkaline earths and ammonia, chloroform being formed, and a formate of the base produced.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr.v.-xx. (.3-1.3).

Action External.—Chloral is a strong irritant applied locally in concentration to the skin and mucous membranes, and if injected under the skin may cause abscess and sloughing. It is a powerful antiseptic, and relieves itching, especially in combination with camphor.

Action Internal.—Alimentary Canal. Chloral produces severe irritation of the mucous membrane in concentrated solution (20 per cent. or over), and large doses may cause vomiting in dogs. The writer has seen intense glossitis and stomatitis follow the breaking of a gelatine capsule, containing chloral, in the mouth of a horse.

Blood.—Chloral is absorbed into the blood unchanged. It was formerly thought that the action of chloral was due to chloroform produced by the decomposition of the former in the alkaline blood. $C_2H\ Cl_3\ O + K\ H\ O = C\ H\ Cl_3 + K\ C\ H\ O_2$ (formic acid).

It is now known that the blood is not sufficiently alkaline to decompose chloral, and that chloroform is not found in the blood, tissues or excretions, except in the case of the urine, when it is strongly alkaline. Moreover, chloral acts as usual upon a frog when the blood of the batrachian is replaced by a neutral saline solution.

Heart and Blood Vessels.—Chloral in large doses depresses the action of the heart muscle and the vasomotor centres. It also produces local paralysis of the vascular walls. Blood pressure is therefore lowered. In small medicinal doses the circulation is not influenced materially, but in poisoning the pulse at first is accelerated and then becomes slow, weak and irregular, and the heart is arrested in diastole.

Nervous System.—The salient action of chloral is exerted upon the brain and cord. Like other narcotics, the depressing effect may be preceded by a transient and unimportant excitation of the brain and cord; but this commonly passes unnoticed, and the prominent action of chloral consists, in ordinary doses, in depressing the sensory and motor centres of the brain, and in larger doses, the spinal reflex activity and the motor tract of the cord. Moderate therapeutic doses cause, therefore, dulness and sleepiness (with contracted pupils) in the lower animals, while doses approaching the toxic point produce insensibility, coma, paralysis of the inferior cornua, with loss of reflex action and muscular power, so that the animal falls with paraplegia, dilated pupils and anesthesia. These symptoms may occur and be followed by recovery. The anesthesia is of spinal

origin. Neither the sensory nerves, motor nerves, nor muscles are affected except in the later stages of poisoning.

Insensibility to pain is said, by Brunton, to follow the action of chloral upon the gray matter of the cord, by preventing the transmission of painful sensations through this tract. It is uncertain whether chloral acts as an hypnotic by its direct depressing influence upon the brain tissue, or by inducing cerebral anemia in causing the blood to be withdrawn from the cerebrum into the dilated peripheral arterioles.

Respiration.—The respiration is not interfered with by moderate medicinal doses of chloral, but toxic quantities depress and paralyze the respiratory centre. The respiratory movements become deep, regular, accelerated and full, with large therapeutic doses, but with toxic doses, slow, irregular and shallow. Death occurs more commonly from arrest of respiration, yet primary heart failure, or both combined, may lead to a fatal result.

Temperature.—The temperature may be elevated at first, but soon falls, owing to diminished heat production and increased loss, through heart failure and vascular dilatation.

Elimination.—Chloral is eliminated by the urine, in part unchanged and in part as urochloralic acid.

Metabolism.—Chloral in large doses leads to increased destruction of the proteids of the body and imperfect oxidation of their products, together with fatty degeneration of the internal organs. These tissue changes are caused by the production of urochloralic acid in the tissues.

Summary.—Chloral is a local stimulant and antiseptic, and relieves itching. It is a powerful depressant to the cerebrum, vasomotor and respiratory centres, inferior cornua, heart muscle and its ganglia.

Acute Poisoning.—Large doses produce insensibility, coma, and complete loss of muscular power, so that the animal falls. There is general anesthesia, and the pupils dilate. The pulse is weak, at first frequent, later infrequent and irregular. The respiration may be primarily quickened, but subsequently becomes slow, shallow and irregular. The animal sweats, sways, gapes and trembles and sometimes falls to the ground, the sphincters are relaxed and involuntary defecation occurs, but recovery commonly follows. With doses greater than 4 ounces, horses die in a generally anesthetic and paralyzed state. In man, death has followed the ingestion of 10 grains of chloral, and several fatalities have occurred after doses of 20 or 25 grains, although these are exceptional cases. The fatal dose for dogs is said to be from 2 to 6 drachms.

Treatment.—Emetics and the stomach tube, shouting at and

beating the animal, external heat. Five times the ordinary dose of strychnine, and a full dose of atropine subcutaneously. Strong, hot coffee and alcohol by the rectum.

Administration.—Chloral has been given intravenously, subcutaneously, and intratracheally, as well as by mouth and rectum. The common way of administering it is in solution per orem or rectum. It may cause abscess if injected under the skin, or thrombi when thrown into a vein. Experiments of Dr. Muir* appear to show that chloral may be safely given intrajugularly; one ounce dissolved in two ounces of sterile water and repeated once in an hour if desirable. If given in ball, the chloral may prove too irritating in the digestive tract. It should be diluted at least 10 times, and is given by the mouth with glycerin and water, or weak syrup, or with boiled starch solution by the rectum.

Uses External.—Chloral may be employed as a stimulant, antiseptic, and slight local anesthetic, in solution (1 to 4), upon ulcers and wounds. It may be used with an equal part of camphor diluted with 8 parts of ointment, to relieve itching. A 4 to 8 per cent. aqueous solution forms an excellent antiseptic preservative for anatomical specimens, and chloral may be added to urine for this purpose.

Uses Internal.—Chloral is used for three purposes in veterinary practice:

1. First and foremost, to relieve spasm.
2. To assuage pain.
3. To procure sleep.

In human medicine chloral is mainly employed as an hypnotic, but a purely soporific action is rarely required for the lower animals. The spasmodic conditions benefited by chloral include colic, convulsion, chorea, epilepsy, asthma, canine distemper, spasmodic cough, rigidity of the uterine os in the first stage of labor, hysteria, cerebritis (to relieve motor excitement), tetanus, and strychnine poisoning. In spasmodic colic, chloral is given dissolved in one pint of linseed oil and, while inferior to opium as an anodyne, has the advantage of not inducing constipation and is often a very successful remedy. It is the best remedy we possess for the treatment of convulsions in dogs, apart from anesthetics. Ether may be administered during the convulsion, and chloral simultaneously, or between the attacks, in gr.v.-xx., per rectum, and repeated if necessary. Chloral is only indicated in chorea when the movements are so severe that the animal cannot secure sleep or rest. In distemper in dogs, chloral is used for the same purpose, when there is excessive cough and restlessness. Chloral is given per rectum in tetanus, so as to keep

* Jour. Compar. Med. and Vet. Archives, April, May, 1900.

the animal continually narcotized, and may be employed in conjunction with tetanus antitoxin.

Spasm of the os uteri is relieved by chloral when given per rectum in frequently repeated doses, until the safe physiological limit is reached. Chloral is inferior to ether or chloroform as an anesthetic, because it is not so safe, nor is the anesthesia so complete, but it relieves pain effectually, and is more easily administered. It is combined, in order to produce anesthesia, with small doses of morphine, which decidedly enhance the anodyne action of chloral.

To prepare a horse for surgical operation, 3 grains of morphine sulphate and 1 grain of atropine sulphate may be injected under the skin, followed in 10 minutes by an enema containing 1 ounce of chloral.*

Class 5.—Antipyretics and Analgesics.

Chloretone. [$CCl_3C(CH_3)_2OH$.]

Chloretone occurs in colorless crystals of camphoraceous odor and bitter taste. It is very slightly soluble in water, soluble in alcohol and in 10 parts of glycerin. It may be made from acetone, chloroform and an alkali.

It is allied to chloral and represents it in action but does not depress the heart and respiration in any ordinary doses and is an actual sedative to the stomach. Externally it is an antiseptic and local anesthetic although there may be some temporary burning produced by it on raw surfaces.

It may be used also as a local anesthetic injected in 1 per cent. solution (alcohol, 15 parts, water, 85 parts). Chloretone is employed with an equal amount of boric acid (Borochloretone) as an application to wounds and ulcers as an antiseptic and local anesthetic.

Internally the drug is administered in human practice before operations to prevent the vomiting subsequent to general anesthesia and its use is advised for the same purpose in dogs and also to quiet the animals for local anesthesia. Unless there is some specific reason

* Chloral (H., ʒ i.-ss.; D., 3 ss.-ii., in 10% solution) injected into the peritoneal cavity will produce surgical anesthesia and is useful in colic in horses with barium chloride by mouth. In flatulent colic, first puncture to allow escape of gas.

The writer has found the method generally safe and efficient in laparotomies in dogs but occasionally inefficient, and deaths have occurred from over-dose and peritonitis. The morphine and drop-ether anesthesia is safer and more satisfactory in dogs.

why vomiting should not occur the subcutaneous injection of morphine is more efficacious to aid the action of either local or general anesthetics.

Chorea and convulsion in dogs may be treated to advantage with the drug.

It may be administered to dogs in pills or capsules.

Dose.—Gr. 5-10; gm. 0.3-0.6.

ACETANILIDUM. Acetanilid. $C_8H_9N\ O$. (U. S. & B. P.)

Synonym.—Phenylacetamide, antifebrin.

An acetyl derivative of aniline.

Derivation.—Glacial acetic acid and aniline are distilled together, and the residue is purified by repeated crystallization. $H\ C_2H_3O_2 + C_6H_5N\ H_2 = C_8H_9N\ O + H_2O$.

Properties.—Colorless, shining micaceous crystalline laminæ, or a crystalline powder, odorless, having a faintly burning taste, and permanent in the air. Soluble in 179 parts of water, and in 2.5 parts of alcohol; also soluble in 12 parts of ether, and easily soluble in chloroform.

Dose.—H., 5 i.-ii. (4.-8.); Sh. & Sw., 5 ss.-i. (2.4.); D., gr.iii.-vii. (.2-.5).

ACETPHENETIDINUM, ACETPHENETEDIN. Phenacetin. $C_{10}H_{13}N\ O_2$ (177.79). (U. S. P.)

Synonym.—Phenacetinum, B. P.; para-acetphenetidin.

Derivation.—Obtained by the action of glacial acetic acid upon paraphenetidin, a phenol derivative.

$H\ C_2H_3O_2 + C_6H_5\ OC_2\ H_5\ N\ H = C_{10}\ H_{13}\ NO_2$.

Properties.—Glistening, colorless, tasteless, odorless, scaly crystals. Practically insoluble in water (1-925), soluble in 12 parts of alcohol, and in glycerin, chloroform and acetic acid.

Dose.—H. & C., 5 ii.-iii. (8.-12.); D., gr.v.-x. (.3-.6).

ANTIPYRINA. Antipyrin. $C_{11}H_{12}\ N_2O$. (U. S. P.)

Synonym.—Phenazonum, B. P.; phenyl-dimethyl-pyrazolon.

Derivation.—Phenyl-hydrazine is acted upon by aceto-acetic ether, when phenyl-monomethyl-pyrazolon, ethyl alcohol and water result.

$H_2N\ N\ H\ C_6H_5 + C\ H_3C\ O\ C\ H_2\ C\ O\ O\ C_2H_5 = C_6H_5\ (C\ H_3)\ C_3H_2N_2O + C_2H_5\ O\ H + H_2O$. Then $C_6H_5\ (C\ H_3)\ C_3H_2N_2O + C\ H_3\ I$ (methyl iodide) $= C_{11}H_{12}N_2O$.

Properties.—Colorless, odorless, scaly crystals, of a bitterish taste and alkaline reaction. Soluble in about its own weight of water, alcohol and chloroform.

Incompatibles.—Spirit of nitrous ether, iron sulphate, chloride and iodide; salicylates, tannin, chloral, calomel, and a large number of drugs.

Dose.—H. & C., ♏ iii.-iv. (12.-15.); Sh. & Sw., ♏ i. (4.); D., gr.v.-xx. (.3-1.3).

ACTION OF ACETANILID, ANTIPYRIN AND PHENACETIN.

External.—Acetanilid and antipyrin are antiseptics. Solutions of the latter contract vessels and exert a local anesthetic and hemostatic state.

Internal.—These substances exert no action upon the digestive tract, but acetanilid possesses a decided antiseptic influence upon bacteria within the alimentary canal.

Blood.—These agents have no influence upon the blood, in moderate medicinal doses, but in large doses (except antipyrin) they diminish the ozonizing power of the blood, reduce the hemoglobin of the red corpuscles, change it to methemoglobin, and alter the color of the blood to a brownish-red hue. In large toxic quantities, administered continuously, they cause disintegration of the red corpuscles and elimination of the blood-coloring matter in the urine.

Heart and Blood Vessels.—In ordinary therapeutic doses these drugs do not alter the normal condition of the heart or blood vessels, but in large medicinal doses they first stimulate and then slow and depress the force of the heart by action (probably) upon the heart muscle. Phenacetin is the least, and acetanilid the most depressant. Antipyrin is said to stimulate the heart and increase blood pressure in minute quantities. These three antipyretics decidedly diminish blood tension in large medicinal doses, owing to depression of the heart and of the vasomotor apparatus.

Nervous System.—Usual therapeutic doses of these substances exert a sedative action upon the sensory nerves and sensory tract of the spinal cord. They are therefore analgesics, although not comparable in this respect to opium. Poisonous quantities of these drugs diminish muscular power, lessen reflex action and cause paralysis. Experiments apparently show that acetanilid paralyzes the motor nerves, antipyrin the motor nerve endings, while motor depression seems to be of spinal origin in the case of phenacetin. The

brain is undoubtedly influenced by these agents, as evidenced by coma and convulsions in poisoning, but exact knowledge is wanting in relation to the action upon the brain. The functions of the cerebral cortex are thought to be depressed by antipyrin, and the special senses to be first stimulated and then paralyzed by this drug.

Temperature.—Acetanilid, antipyrin and phenacetin are essentially antipyretics. While they do not invariably lower temperature, even in large doses in normal animals, they do so very materially in animals suffering from fever. They apparently depress the activity of the calorefacient centres (probably in the corpora striata), and therefore diminish heat production. Testimony is at variance in regard to their action upon heat loss. They frequently induce diarphoresis, but it is generally accepted that heat dissipation is increased to a greater extent than would be accounted for by sweating, and that it occurs even when diarphoresis does not take place. Experimenters vehemently disagree as to which preponderates—increased heat loss or lessened heat-production—in causing antipyresis.

Respiration.—The respiratory functions are unaffected by therapeutic doses of these medicines. In lethal doses respiration is quickened, owing to the greater work thrown upon the respiratory centre by the altered condition of the blood, and this vital centre is ultimately paralyzed.

Kidneys.—The drugs under consideration produce slight diuresis in moderate medicinal doses. In poisoning, the urine may become dark-colored by the hematin escaping from the disintegrated red blood corpuscles. Antipyrin lessens the nitrogenous products of tissue waste in the urine, and also diminishes the amount of that secretion. Acetanilid, on the other hand, increases the excretion of urea.

Elimination.—Antipyrin is rapidly eliminated unchanged in the urine in some animals; in others it is oxidized. Acetanilid escapes in part unchanged and in part as different oxidation products in different animals; while phenacetin is chiefly eliminated as such and as glycuronate of phenetidin.

Poisoning.—Toxic doses of these drugs cause, in the lower animals, nervous excitement and convulsions, and sometimes coma, loss of consciousness, staggering gait, muscular failure, sweating, rapid, feeble respiration, weak pulse, cyanosis, occasional vomiting in dogs, fall of temperature and general paralysis.

Treatment.—External heat, alcoholic stimulants by the mouth, rectum, or under the skin; digitalone, strychnine, and atropine subcutaneously.

Administration.—Antipyrin is given in solution by the mouth, rectum, or under the skin. Acetanilid and phenacetin can be administered in powder, tablet, pill or ball; or in solution in alcoholic liquor. Acetphenetidin is to be preferred for horses on account of its being less depressant. The average dose of acetanilid is one drachm for a horse, and three to five grains for a dog; and the dose of phenacetin is twice, and of antipyrin three times greater than that of acetanilid.

Uses External.—Acetanilid is employed as an antiseptic dusting powder undiluted. A ten per cent. solution of antipyrin may be applied as a hæmostatic upon bleeding surfaces.

Uses Internal.—There are three indications for the use of these agents: 1. To lower temperature in fever. 2. To relieve pain. 3. To lessen motor excitement and spasm.

While these agents are used chiefly in human medicine to relieve pain, especially of a neuralgic character, this kind of suffering is uncommon in veterinary practice and here acute rheumatism is the disease chiefly amenable to their influence. In rheumatism the salicylates should be employed with the antipyretics, as sodium salicylate in solution with antipyrin.

Phenacetin is the most serviceable for dogs, as it is less toxic, more sedative, and more permanent in its antipyretic action than antipyrin or acetanilid. Dogs suffering from distemper are greatly relieved by small and repeated doses of phenacetin, which lessen fever, cough and restlessness. In acute diseases, as pneumonia, influenza and laminitis, either of the antipyretics may be employed in one or two doses when there is hyperpyrexia.

Although animals do not seem to be so susceptible to the depressing influence of the antipyretics yet it is well to combine them with caffeine or strychnine. They are generally inadvisable in asthenic febrile diseases, since they are too depressant in their action upon the heart and have no effect in removing the cause of the disease. The hyperpyrexia of isolation may be treated with these agents, in combination with cold, externally and per rectum. Motor disturbances, including convulsions, chorea and spasm, may be abated by the antipyretics, but they are usually inferior to chloral, opium, or other antispasmodics.

Phenacetin, combined with codeine or heroin, in powder or tablet, is a useful remedy for cough in dogs.

Class 6.—Antiseptics.

Acidum Carbolicum Crudum. Crude Carbolic Acid.

Synonym.—Acide phénique cru, Fr.; rohe carbolsäure, G.

Derivation.—A liquid consisting of various constituents of coal tar, chiefly cresol and phenol, obtained by fractional distillation at a temperature between 302° F. and 392° F., and twice rectified at a temperature between 338° F. and 374° F.

Properties.—A nearly colorless, or reddish-brown liquid of a strongly empyreumatic and creasote-like odor, having a benumbing, blanching and caustic effect upon the skin or mucous membrane, and gradually turning darker on exposure to the air and light. Soluble in 15 parts of water. The aqueous solution has a slight acid reaction.

Phenol (U. S. P.)

*Acidum Carbolicum. Carbolic Acid. C_6H_5O H. (B. P.)

Synonym.—Hydroxybenzene, phenic acid, phenyl alcohol, phenylicum crystallisatum, E.; acide phénique, acide carbolique, hydrate de phényle, Fr.; carbolsäure, phenyl alkohol, G.

Derivation.—Obtained from crude carbolic acid by agitation with caustic soda, heating to 338° F., and adding hydrochloric acid. Then by agitation with sodium chloride, digestion with calcium chloride, and distillation at a temperature between 336° F., and 374° F., and finally by crystallization.

Properties.—Colorless, interlaced, or separate, needle-shaped crystals, or a white crystalline mass, sometimes acquiring a reddish tint; having a characteristic, somewhat aromatic odor, and when copiously diluted with water, a sweetish taste with a slightly burning after-taste. Deliquescent on exposure to damp air. Soluble in about 19.6 parts of water, and very soluble in alcohol, ether, chloroform, glycerin, fixed and volatile oils. Faintly acid reaction.

Phenol crystals melt when heated, but solidify again on cooling. A 95 per cent. solution of carbolic acid crystals, in alcohol, remains fluid at the ordinary temperature. The crystals are also liquified by the addition of about 8 per cent. of water.

Dose.—H. & C., 3ss.-ii. (2.-8.); Sh. & Sw., gr.x.-xx. (0.6-1.3); D., gr.ss.-i. (.03-.06).

* The U. S. P., 1905, recognizes only "Phenol" as the official name for carbolic acid.

PREPARATIONS.

Unguentum Acidi Carbolici. Ointment of Carbolic Acid. (B. P.)
Unguentum Phenolis. (U. S. P.)

Phenol, 3; ointment, 97 (U. S. P.); 4 per cent., B. P.

Glyceritum Acidi Carbolici. Glycerite of Carbolic Acid. (B. P.)
Glyceritum Phenolis. (U. S. P.)

Phenol, 20; glycerin, 80.

Acidum Carbolicum Liquefactum. Liquified Carbolic Acid. (B. P.)
Phenol Liquefactum. (U. S. P.)

Carbolic acid liquified by addition of 10 per cent. of water.
Dose.—Same as acidum carbolicum.

Action External.—Carbolic acid causes burning pain when applied to the skin or mucous membranes, and this action is followed by local anæsthesia and the production of a dry white spot. If used in sufficient quantity, it leads to sloughing, but the escharotic effect is superficial, since the acid coagulates albumin, which forms a protective coating over the underlying parts. Carbolic acid is an antiseptic and disinfectant, and, in proper solution, acts as a sedative upon the peripheral sensory nerves, and is one of the most efficient agents in relieving itching. It checks the growth of both organized (bacteria) and unorganized (digestive) ferments. Strong solutions (1-2 per cent.) kill most bacteria, but a considerable time is required to destroy the organisms of certain diseases and those relating to putrefaction. Some hours are required to kill anthrax spores, by even a 5 per cent. solution. Two per cent. solutions destroy the digestive ferments. The lower forms of vegetable parasites, growing upon the skin, perish by the application of carbolic acid.

Action Internal.—Alimentary Canal.—Carbolic acid exerts a local, anæsthetic action upon the sensory nerve endings in the stomach, and may act to a certain extent in the digestive tract as an antiseptic, hindering abnormal fermentation. It is probably converted into a sulpho-carbolate in the stomach. In concentration, carbolic acid is a powerful gastro-intestinal irritant.

Blood.—Carbolic acid is absorbed into the blood and probably circulates in part as an alkaline carbolate of sodium and potassium.

Heart and Blood Vessels.—Phenol, in poisonous doses, paralyzes the vasomotor centre and later depresses the heart. The effect upon the vessels is the more important and prominent, but neither action is observed after medicinal doses.

Respiration.—Therapeutic doses do not influence the respiratory functions, but toxic quantities make the respiratory movements rapid

and shallow at first, owing to stimulation of the respiratory centre and peripheral vagi, while death occurs after lethal amounts from paralysis of the respiratory centre.

Nervous System.—The brain is depressed by toxic doses of carbolic acid, and stupor and coma occur. The convulsions appearing in carbolic acid poisoning are due to primary stimulation of the spinal motor area, which is finally depressed and paralyzed. When locally applied, carbolic acid depresses and paralyzes the peripheral sensory nerves.

Temperature.—Carbolic acid, in medicinal doses, slightly lowers temperature both in health and fever, but is not sufficiently antipyretic to be suitable for such a purpose in practice. It depresses heat production and increases heat loss.

Elimination.—Carbolic acid is eliminated by all ordinary channels, but mainly by the kidneys. The urine becomes dark colored—a very characteristic sign—even after large medicinal doses. Phenol normally occurs in small quantities in the urine of man and animals. Three grains have been recovered from the urine passed in 24 hours by a horse, and phenol is thought to be a product of intestinal fermentation. In large toxic doses most of the carbolic acid is eliminated in the urine unchanged. Part, however, is oxidized into two bodies—pyrocatechin and hydroquinone—and these, as well as phenol, unite with sulphuric and glycuronic acids in the tissues. Thus phenol is eliminated in the urine as double sulphates and glycuronates of phenol, pyrocatechin and hydroquinone. The last two are unstable and further undergo oxidation into dark substances, coloring the urine, which grows darker on exposure to the air. The normal sulphates are absent in the urine following carbolic acid poisoning.

Toxicology.—Carbolic acid ranks as one of the most powerful poisons—together with prussic acid and nitrobenzole—in existence. Several cases of death in man have occurred after the ingestion of one-half an ounce of carbolic acid; and the smallest fatal human dose on record appears to be about one drachm. One or two drachms are fatal to dogs, and a dose as small as 15 grains is said to have caused the death of a dog, while the lethal amount for the horse is about one ounce. Many cases of accidental poisoning have occurred from absorption of carbolic acid when applied externally for surgical purposes in dressings or solutions upon raw surfaces. The symptoms are the same as when absorption occurs from the digestive tract. Extensive gangrene, after continuous treatment with moist carbolic applications, is occasionally seen. Dogs and cats are particularly susceptible to the action of phenol. The milder symptoms of poisoning include dulness, loss of appetite, muscular weak-

ness and trembling, and dark-colored urine having the odor of carbolic acid. After lethal doses death may be instantaneous through respiratory arrest, the heart continuing to beat for a time. The more ordinary symptoms in severe poisoning in all animals are: trembling, rarely vomiting and purging, restlessness, salivation, loss of muscular power (animal reels and falls), diminution of sensibility, anæsthesia, dyspnœa; the breathing is rapid, shallow and stertorous; the pulse is weak, irregular, and usually frequent; the temperature is lowered, and there are the usual symptoms of collapse, with insensibility, coma, loss of reflex action, general paralysis, occasional convulsions and death. Sometimes hematuria, albuminuria and hemoglobinuria have been observed. The condition resembles apoplexy, but the mucous membrane of the mouth is stained white in patches after ingestion of pure acid, dark with crude acid, and the odor of the poison lingering about the animal, together with the dark, green-colored urine, are characteristic of phenol poisoning. The urine may be clear when first voided, but becomes dark on standing.

The absence of carbolic acid in the urine affords certain evidence that the case is not one of poisoning by this drug. Postmortem examination reveals hard, whitish or brownish or black patches and sloughs upon the mucous membrane of the mouth, gullet, stomach, and even the small intestines. The blood is dark from asphyxia, and imperfectly coagulated. There is occasionally fatty degeneration of the liver and kidneys. The odor of the acid remains not longer than twenty-four hours.

Treatment.—Unfortunately there is no satisfactory antidote for phenol. Emetics are usually valueless on account of the anesthetic condition of the mucous membrane of the stomach. We use, therefore, the stomach tube. Washing the stomach with 10 per cent. solution of alcohol has proven most efficient. This follows because alcohol is a good solvent for phenol. The alcoholic solution of phenol should, therefore, be at once removed from the stomach or its use will aid absorption and poisoning. After washing the stomach with alcohol one should give a strong solution of magnesium or sodium sulphate by the mouth or, when lavage is impracticable, one of these should be given at once. Concerning their action and value there could scarcely be more disagreement. Thus it has hitherto been commonly accepted and taught that insoluble sulphocarbolates are formed in the stomach. This is now denied by Sollman and most authorities. Thornton affirms, as a result of his experiments, that harmless but soluble phenosulphates result. This, again, is denied by Baumann and others. Cushny declares that the employment of these sulphates in phenol poisoning is useless, while Hare advises

their use. As the action of Epsom or Glauber's salts is harmless and their effect may be beneficial, we recommend their administration. For collapse, heart and respiratory failure,—camphorated oil, digitalis, strychnine, atropine, ether, and brandy subcutaneously, are to be employed, together with heat externally. Mucilaginous drinks are also useful. The local caustic action of carbolic acid on the skin or mucous membranes can be prevented by the immediate washing of the parts with strong alcohol. Of late years alcohol has also been regarded and widely given as a physiological and chemical antidote in carbolic poisoning. In experiments, cited by Thornton,* on dogs with mixtures of toxic doses of carbolic acid and alcohol, and with the administration of poisonous doses of the acid followed by alcohol, the results go to show that alcohol does not in any way lessen or alter the poisonous effect of carbolic acid except in preventing the corrosive action on the stomach. His conclusions are somewhat weakened, however, by the fact that doses of alcohol were used which in themselves might be toxic (4 to 9 ounces). It is now known that alcohol acts only as a solvent; not as an antidote.

Administration.—Carbolic acid is commonly given internally, diluted several hundred times with water.

Uses External.—A solution of carbolic acid (1-20) is frequently used in surgery to disinfect the unbroken skin, while a weaker solution (1-50) is more suitable as an antiseptic upon raw surfaces and mucous membranes. While corrosive sublimate has enjoyed chief popularity as a surgical antiseptic for many years on account of its cheapness and supposed superior bactericidal properties, recent experiments (see p. 202) have shown that the value of corrosive sublimate is much over-estimated. It has been shown that while a 1 to 2000 solution of corrosive sublimate requires over thirty minutes to kill micro-organisms the same bacteria are killed in less than one minute by a 5 per cent. solution of carbolic acid (Post and Nicoll). So, while the antiseptic reputation of phenol has been rehabilitated, yet its closely related chemical substitutes, cresol, creolin and lysol, have largely replaced phenol on account of their being less toxic and more actively germicidal, strength for strength. Pure carbolic acid is occasionally used as a caustic to destroy small growths, as warts, and the lining membrane of fistulæ of the poll, withers, or lateral cartilages; to swab out a septic uterus, and as a local anæsthetic upon the skin. A drop of pure acid, or a line drawn with a brush along a proposed path of incision, may render a hypodermic puncture or superficial incision painless. Carbolic acid with glycerin (1-16) is one of the most excellent preparations for applying to sluggish ulcers and old sinuses and fistulæ. The glycerin appears to entirely offset

* Progressive Medicine, p. 345, Dec., 1901.

the corrosive action of the acid, and the result is a stimulation of the pyogenic membrane and promotion of healing which often can not be obtained by any other remedy. It is equally effective in canker and foul in the foot of cattle, and in foot rot of sheep (1 part in 10 of glycerin). Injection of ten to thirty drops of a two per cent. aqueous solution into the substance of boils, acne, glandular swellings, poisoned wounds, joints affected with chronic synovitis, and inflamed bursæ, will often assist recovery and may abort the lesion. In the two last, ♏x-xxx. of the pure acid.

In acute inflammation, the injections are made twice daily; in chronic conditions, once every other day; and if there is a large extent of surface involved, several injections are done at one time.

Erysipelatous patches are best treated by swabbing them with pure phenol followed at once by swabbing with pure alcohol. This is done not only to the patch itself but the surrounding normal area should be somewhat encroached upon.

Wet dressings, made by saturating aseptic gauze in ½ to 1 per cent. solutions of phenol and applied with a rubber cloth or oil paper or silk covering, have been much used in surgery in the treatment of septic wounds. Many cases of local gangrene have been reported in human surgery following such application to the extremities. It is safer and just as effective to use a 1 per cent. lysol (liq. cresolis co.) solution for an antiseptic wet dressing.

Bacelli's treatment of tetanus with carbolic acid is much more successful than with antitoxin (90 per cent. cured). One drachm of the pure acid in solution (3 to 5 per cent.) should be injected subcutaneously in the region of the neck and shoulders of the horse every two hours during the first 32 hours, and less frequently afterward. As much as 36 drachms may be given to the horse in 24 hours, for there appears to be a special tolerance for carbolic acid acquired in tetanus.

Instruments are frequently placed in carbolic acid solution (1-40) during surgical operations, although it is sufficient to boil them in water for ten minutes, and keep them in the boiled water, or place them in a pure atmosphere upon boiled towels. Carbolized gauze is prepared from unbleached cotton gauze medicated with half its weight of a mixture consisting of carbolic acid, 1; resin, 3; and paraffin, 4 parts. Plain gauze, sterilized by baking at a temperature of 140° C. for two hours, is preferable, and avoids the danger of absorption and poisoning.

The glycerite of carbolic acid is employed as a local application in stomatitis, upon the ulcerations of actinomycosis with iodine, and also upon the skin to destroy ringworm. It is inferior, however, to tincture of iodine for the latter purpose. Two per cent. solutions

are recommended to kill lice and the acari of scab and mange. Carbolic acid is the most serviceable remedy we possess to relieve itching. Two per cent. solutions may be employed upon the unbroken skin, but the strength should not be greater than half this amount upon excoriated surfaces. In sub-acute moist eczema of dogs, carbolic acid with zinc ointment (gr.5-℥. i.), or the following prescription, will be found of value in relieving itching and promoting recovery:

℞

Calaminae	℥ ss.
Zinci oxidi	3 ii.
Acid. Carbol	gr. xx.
Liq. Calcis ad	℥ iv.

M.

Sig. External use. (Shake.)

Care should always be taken not to apply carbolic preparations over any considerable extent of raw surface, and to muzzle dogs in the event of an opportunity being afforded them to lick off any undue amount of the acid. A solution (1-50) in boiling water forms an efficient antiseptic and sedative inhalation for horses suffering from catarrh of the upper air passages. One of the most excellent remedies for burns consists of a one per cent. solution of carbolic acid in carron oil. It relieves pain and lessens suppuration, although carbolic acid in oil possesses little antiseptic property, because phenol is so much more soluble in oil than in the watery protoplasm of bacteria. Good results have been reported with intratracheal injections in verminous bronchitis of foals and calves, consisting of the following:

℞

Acidi carbolici	♏xx.
Ol. terebinthinae	3 ii.
Chloroformi	3 ss.

M.

Sig. Give at one injection intratracheally.

Phenol, 1 part; with camphor, 3 parts; forms a liquid which is without the toxic and caustic properties of phenol alone. It makes a serviceable application for small burns, wounds and ulcers, as in broken knees and in necrosis of the coronary band in horses.

Phenol is useful as a spray in the form of Dobell's solution which is indicated in coryza, in influenza and distemper.

℞
Sodii bicarb.
Sodii boratis . . . . . āā 3 i
Phenol . . . . . 3 ss
Glycerini . . . . . 3 i
Aquae . . . . . O ii
Sig.—Dobell's solution. Apply with atomizer or syringe.

Crude carbolic acid may be used in 5 per cent. solution to disinfect infected buildings and their contents, and, with whitewash, can be applied to walls after cleaning.

To be more precise, the strength of crude carbolic acid for disinfection depends upon the amount of cresylic acid it contains, which may be ascertained from the dealer. The disinfectant solution of crude carbolic acid should be such that it will contain 2 per cent. of cresylic acid.

Commercial cresol (containing over 90 per cent. of pure cresol) is more effective and cheaper than crude carbolic acid as a disinfectant. It should be dissolved in hot water and used in 2 per cent. solution.

A 5 per cent. cresol solution is useful in the form of a foot bath in a shallow trough for foot rot in sheep, which are driven through it thrice weekly.

Uses Internal.—The systemic action of carbolic acid after absorption is of value in some general bacterial diseases.

This is most notable in the case of tetanus, as has been seen. Moreover, the subcutaneous injection of 2 drachms (8 cc.) of a 3 per cent. aqueous solution of carbolic acid every ten days into all pregnant cows during the prevalence of epizootic abortion has been extensively employed as a prophylactic measure. Recent reports discredit the value of this treatment, however. In the carbuncle form of anthrax in man, the injection of carbolic acid has yielded successful results and it may be tried in cattle. But speedy destruction of anthrax patients in veterinary practice is usually the only wise procedure. Locally, carbolic acid may exert an antiseptic and anesthetic action in the stomach. Carbolic acid is sometimes of service in relieving vomiting and gastric pain caused by flatulence in dogs, and in counteracting intestinal fermentation and diarrhea in all animals. In diarrhea of dogs, grain doses are combined to advantage with bismuth subnitrate in powder, capsule, or pill.

Creosotum. Creosote. (U. S. & B. P.)

Synonym.—Kreosotum, P. G.; kréosote, Fr.; kreosot, G.

Derivation.—A mixture of phenols and phenol derivatives,

chiefly guaiacol and creosol, obtained during the distillation of wood tar, preferably of that derived from the beech, Fagus sylvatica Linné. (Nat. ord. cupuliferæ.)

Properties.—An almost colorless, yellowish or pinkish, highly refractive, oily liquid, having a penetrating, smoky odor, and a burning, caustic taste. Usually becoming darker in tint on exposure to the light. Spec. gr. not below 1.070 at 59° F. Soluble in about 140 parts of water, but without forming a perfectly clear solution. Freely soluble in alcohol, ether, chloroform, acetic acid, fixed and volatile oils.

Dose.—H., ℥v.xv. (.3-1.); D., ℥ss.-ii. (.03-.12).

Action and Uses.—The action of creosote upon animals is practically the same as that of carbolic acid in kind, but is much less toxic. The antidotes and treatment of poisoning are also similar. *Externally,* creosote is as effective a germicide as carbolic acid, but the latter is usually preferred, being much cheaper. Creosote may be applied in the same strength for its local antiseptic, parasiticide, and local anæsthetic action. It is employed in skin diseases and especially those of parasitic origin. In scab 1 part is dissolved in 65 parts of 50 per cent. alcohol, and in follicular mange of dogs it may be applied with olive oil (1 to 14) to which is added two parts of potassium hydroxide. *Internally,* creosote is administered, as is carbolic acid, to check vomiting and to act as an intestinal antiseptic in indigestion with fermentation and diarrhea. Creosote is of much service as an inhalation (℥xx. to Oi. of boiling water) in sub-acute bronchitis, in fetid nasal discharge and in gangrene of the lung in horses. It is occasionally given by intratracheal injection (creosote, ℥x. in ʒ ss. of 50 per cent. alcohol) in gangrenous pneumonia of horses and to sheep and calves in the same manner in parasitic bronchitis (℥v. in ʒ i. 50 per cent. alcohol). It may also oe given by the mouth in verminous bronchitis so as to kill the filaria in its elimination by the bronchial mucous membrane. Neumann advises creosote (ʒ ii.), benzine (ʒ x.), and water (2 qts.); of the mixture for sheep, 1 teaspoonful daily, by the mouth, for 8 days for verminous bronchitis.

Cresol. Trikresol. C_7H_7OH.

A mixture [C_6H_4 (CH_3) O H] of the three isomeric cresols obtained from coal tar, freed from phenol, hydrocarbons and water. It should be preserved in amber-colored bottles from the light. A colorless, or straw-colored refractive fluid, having a phenol-like odor, and turning yellowish-brown on prolonged exposure to light. Spec. gr. 1.032. Cresol is soluble in 60 parts of water at 77° F.: miscible

in all proportions with petroleum benzine, benzene, alcohol, ether and glycerin; miscible with alkali hydroxide solutions. The three cresols are meta-, ortho- and para-cresol. They are constituents of tars and are related to carbolic acid chemically and therapeutically. To increase their solubility as antiseptics they are suspended with soap (lysol), used in emulsion (creolin), or dissolved by salts (solveol). Cresol ranks favorably with phenol as an antiseptic but is used more commonly in the form of creolin and lysol. The dose of cresol is the same as that of phenol.

Creolinum. Creolin. (Non-official.)

Derivation.—Obtained from soft coal by dry distillation. Composition very complex. It is said to contain cresol and higher homologues of phenol.

Properties.—Dark-brown, syrupy, alkaline liquid, of a tarry taste and odor. Nearly soluble in alcohol; soluble in chloroform and ether. When added to water, creolin forms a white emulsion containing in suspension as much as 12 per cent. of the drug.

Dose.—H. and C., ʒ ss.-i. (15.-30.), in single dose. For continuous use—H. and C., ʒ i.-ii. (4.-8.); D., ♏ i.-v. (.06-.3).

Action External.—Creolin is a powerful and useful disinfectant, antiseptic, and parasiticide. It forms a slippery coating upon the skin. Strong solutions are not caustic, but may cause a dermatitis when continuously applied. Creolin generally represents carbolic acid, but is much more efficient as a germicide, less irritating, and does not endanger animal life from absorption.* Aqueous solutions (emulsions), containing from ½ to 1 per cent., are employed for antiseptic purposes.

Action Internal.—Creolin is eliminated by all channels, giving the secretions a tarry odor, and coloring the urine brown. One or two drachms of creolin (a lethal dose of carbolic acid), when given daily to dogs for weeks at a time, produce no bad effects. It is a good intestinal antiseptic, and better than carbolic acid.

Uses.—Creolin is employed mainly outside of the body, and is a useful general antiseptic for surgical purposes in 1 per cent. solution. Antiseptic poultices, so valuable upon septic sloughing parts, are best made by soaking clean gauze in a 1 per cent. aqueous solution of creolin, and applying the same, covered by a waterproof protective. Creolin solutions are not to be recommended for instruments during operations, as the fluid is so turbid that they cannot be seen by the operator. A 2 per cent. solution is useful for a

* Creolin, to avoid toxic effects, should be pure. That made by Merck is a reliable article.

vaginal or uterine injection; a 1 per cent. solution for irrigation of the bladder in cystitis, or eye in keratitis and conjunctivitis; and a ½ per cent. solution for intestinal irrigation in dysentery. As a parasiticide, 2 per cent. solutions, or 10 per cent. ointments or soaps, may be used to kill lice, fleas, and acari of scab and mange. Frohner advises equal parts of creolin and alcohol, with 8 parts of green soap, in mange and scab with occasional use of a 2 per cent. bath. The same treatment is useful in chronic mange and grease. With alcohol (1-10-20) creolin is remedial in alopcia areata.

Sheep are dipped to advantage in 2 per cent. solutions, to destroy ticks, instead of the more dangerous arsenical liquids. Creolin (of Merck) may be used internally, as an intestinal antiseptic and anthelmintic. One ounce given on an empty stomach, in a quart of water, is one of the most effective vermifuges for the horse.

Lysolum. Lysol.

A preparation, *Liquor Cresolis Compositus* (U. S. P.), is now official and represents lysol. It has the advantage of being cheaper than lysol.

Derivation.—From that part of tar oil which boils between 190° and 200° C., by dissolving in fat and saponifying in alcohol.

Properties.—A clear, brown, oily liquid, of a feeble, creosote-like odor. Soluble in water, forming a clear, frothy, soapy fluid, and in alcohol, chloroform, and glycerin. Lysol contains 50 per cent. of cresol.

Lysol is used as a substitute for creolin, in ½ to 2 per cent. aqueous solution. It is a powerful antiseptic, and is stated to be half as poisonous as creolin, and only ⅛ as toxic as carbolic acid. A 1 per cent. solution of lysol is more effectively antiseptic than similar solutions of either phenol, creolin or a 1 to 1000 solution of mercuric bichloride. The latter requires over one half hour to kill most pathogenic micro-organisms. One per cent. lysol destroys streptococci within one minute. Two per cent. solutions are useful in irrigating wounds and for making wet dressings and vaginal injections. Lysol should be bought under its official name (liq. cresolis co.), as it is then much cheaper. Solutions do not roughen the surgeon's hands, and instruments submerged in them are not injured or obscured.

The drug Liquor Cresolis Compositus is perhaps the most widely used and valuable surgical antiseptic and disinfectant at our disposal at the present time.

Betanaphthol. $C_{10}H_7O$ H. (U. S. P.)

Synonym.—Naphtol.

A phenol occurring in wood tar, but usually prepared artificially from naphthalin.

Derivation.—Naphthalin is treated with strong sulphuric acid. B-naphthalin sulphonic acid is formed $C_{10}H_7$ H SO_3). The latter acid is dissolved in water with milk of lime, and the resulting calcium salt is recovered by crystallization. The crystals are then dissolved in water and treated with sodium carbonate, when sodium naphthalin-sulphonate (C_{10} H_7 SO_3 Na) results. The latter is mixed with fused sodium hydroxide, when sodium naphtol $C_{10}H_7$ O Na) and sodium sulphite are obtained. Hydrochloric acid is added to the former, and naphtol results, which is further purified by sublimation and recrystallization.

Properties.—Colorless, or pale buff-colored, shining, crystalline laminæ, or a white, or yellowish-white, crystalline powder; having a faint phenol-like odor, and a sharp and pungent but not persistent taste. Permanent in the air. Soluble in about 950 parts of water, and in 0.61 parts of alcohol; also very soluble in ether, chloroform, or solutions of caustic alkalies.

Dose.—H., ʒ ii.-iii. (8.-12.); D., gr.i.-x. (.06-.6).

Actions and Uses.—Naphtol is a powerful disinfectant, antiseptic and parasiticide. It is said to be several times more germicidal than phenol. B-naphtol somewhat resembles carbolic acid in its toxic effect. It irritates the mucous membranes, causing sneezing and coughing in the respiratory tract, nausea and diarrhea when swallowed, and acute nephritis, with inflammation of the urinary tract and strangury in its elimination. It is a useful application externally in 10 per cent. ointment, for mange and ringworm.

Internally it is employed to kill round and tape worms, and as an antiseptic in intestinal fermentation. It should be given in keratin coated pill (to avoid irritating the stomach), or capsules, to dogs, and in ball to horses.

Naphthalenum. Naphthalene. C_{10} H_8. (U. S. P.)

Synonym.—Naphtalin.

Derivation.—A hydrocarbon obtained from coal tar by distillation between 356° F. and 482° F. The impure naphtalin resulting is treated with sulphuric acid and sodium hydroxide, and is further purified by distillation with steam, and then by mixture with strong sulphuric acid, and finally by redistillation.

Properties.—Colorless, shining, transparent laminæ, having a strong characteristic odor resembling that of coal tar, and a burning aromatic taste; slowly volatilized on exposure to the air. Insoluble in water; soluble in 13 parts of alcohol; very soluble in ether, chloroform, carbon disulphide, and fixed and volatile oils.

Dose.—H., 3 ii.-iv. (8.-15.); D., gr.i.-xx. (.06-1.3).

Actions and Uses.—Naphthalene produces in poisonous doses diarrhea and emaciation, nephritis and retinal degeneration with cataract. It is oxidized in the body and eliminated in the urine as beta- and alpha-naphtol, but while thus sterilizing the urine neither naphthalene nor naphtol should be employed when there is irritation of the urinary tract. Naphthalene, like other coal tar products, is an antiseptic and parasiticide. It may be used as an antiseptic dressing powder upon wounds, or in 10 per cent. ointment for parasitic skin diseases. Naphthalene is almost insoluble in the digestive tract, and acts as an antiseptic, therefore, throughout this canal. It is of service in intestinal fermentation, diarrhea, dissentery, and as a vermicide in combination with castor oil. Naphthalene is administered to dogs in starch wafers or gelatine capsules; and to horses in ball or electuary.

Resorcinol. $C_6H_6O_2$. (U. S. P.)

Synonym.—Resorcinum. Resorcin. Metadioxybenzol.

Derivative.—A diatomic phenol formed by the action of fuming sulphuric acid upon benzine, whereby benzine metadisulphonic acid [C_6H_4 (H S O_3)$_2$] results. The latter is neutralized by milk of lime; calcium sulphate is expressed, and sodium carbonate is added. The process is continued by filtration, and the filtrate evaporated to dryness. The residue is heated with sodium hydrate, with the formation of sodium resorcin [C_6H_4 (O Na)$_2$].

Sulphurous acid is driven off from sodium resorcin by boiling, and the result is extracted with ether; impure resorcin is recovered by distillation, and is purified by sublimation or by recrystallization from water.

Properties.—Colorless, or faintly reddish, needle-shaped crystals, or rhombic plates; having a faint, peculiar odor, and a disagreeable, sweetish, and afterward pungent taste. Resorcin acquires a reddish or brownish tint on exposure to light and air. Soluble in 0.5 part of water, and slightly more soluble in alcohol; readily soluble in ether or glycerin, and very slightly soluble in chloroform.

Dose.—H., 3 iv.-vi. (15.-24.); Foals and Calves, 3 ss.-i. (2.-4); D., gr.ii.-v. (.12-.3).

Action and Uses.—Resorcin was originally employed as an antipyretic, but is not now used for this action, being too depressing to the heart. It is an efficient antiseptic, externally and internally;

possesses a slight local anesthetic effect, and is not nearly so irritating topically as phenol. Resorcinol is chiefly used in skin diseases to cure itching, scaling and induration in subacute and chronic eczema. It may be combined with zinc ointment (1 to 8), or is used in solution with glycerin and lime water, gr.xv. to xx. to the ounce. Internally, resorcin is of worth in diarrhea and fermentation.

Formaldehyde. C H O H.
(Non-official.)

Synonym.—Formic aldehyde.

Derivation.—Obtained by partial combustion of wood alcohol, without ignition, by evaporation of the spirit in contact with a hot, platinized, asbestos plate. $2\ C\ H_3\ O\ H + O_2 = 2\ C\ H\ O\ H + 2\ H_2O$.

Properties.—Formaldehyde is a pungent gas, having a spec. gr. of 1.6; soluble in water, forming a clear, colorless, stable solution when kept in glass-stoppered bottles, but volatilizing on exposure to the air. Formalin was the commercial name for an aqueous solution containing 40 per cent. of formaldehyde gas, but is now official.

PREPARATION.

Liquor Formaldehydi. (U. S. P.)

Formalin. Containing not less than 37 per cent. of formaldehyde gas.

Action and Uses.—Formaldehyde and formalin are powerful microbicides. A 1 per cent. solution of formalin will kill Staphylococcus pyogenes aureus in about an hour; B. typhosus in 40 to 50 minutes; B. coli communis in 30 to 40 minutes; B. anthracis and S. choleræ in less than 15 minutes. Clothes soaked in cultures of B. typhosus, S. choleræ and Staphylococcus pyogenes aureus, and then for 24 hours in a 1 per cent. solution of formalin, were found to be completely sterile (Slater). Trillat and Robinson have apparently shown that formaldehyde gas has wonderful disinfectant and penetrating properties, destroying all pathogenic bacteria in ordinary rooms containing the microorganisms buried under mattresses, between blankets, in clothing and other articles, in the air, dust, and morbid secretions. Harrington has proved, however, that the penetrating power of formaldehyde is nil in the case of moist substances, and that sterilization is not always complete when microorganisms are imbedded in, or covered by, dry pervious material. Still, formaldehyde is the best gaseous disinfectant now known for the sterilization of infected premises. It does not kill insect pests, animal

parasites or rats, but burning sulphur is effective for this purpose. The gas is most effective between 60 degrees and 70 degrees F. It should not be used if air temperature is below 50 degrees F. The premises containing the gas should be sealed from 4 to 24 hours. Formaldehyde vapor is extremely pungent and irritating to the mucous membranes, causing running of the nose and eyes in those exposed to its influence; but some experimenters have subjected animals to formaldehyde vapor (of disinfectant strength) for hours without causing their death. In Harrington's experiments two rabbits were killed by formaldehyde in the disinfection of a room, and exhibited the following *post-mortem* appearances: Congestion and hemorrhage of the buccal mucous membrane; intense bronchitis with hyperemia, and consolidation of the lung with a purulent and slightly fibrinous exudate. There was also congestion of the abdominal organs, including the liver, kidneys and spleen. As death may occur, it is certainly unwise to attempt the disinfection of premises with formaldehyde, when inhabited by men or animals.

The injection of 2 per cent. formalin in glycerin into badly infected and suppurating joints has proved unusually successful in human surgery. From 2 to 4 drachms are used, after aspiration, and the injection may be repeated 3 times, a week apart. The joints are immobilized meanwhile. The solution should never be used until it is 24 hours old.

Internal Action.—Solutions of formaldehyde are intensely irritant. Nausea, vomiting, coma with slow pulse, and death have followed its ingestion. The red blood cells are altered in form, and destructive changes have been noted in the liver and kidneys. Formaldehyde escapes unchanged in the urine.

Uses.—Formic aldehyde vapor is not injurious to clothing, metals, or other like articles, as are sulphurous anhydride or chlorine gas, and it bids fair to supersede all other agents for the gaseous disinfection of premises infected with pathogenic bacteria. Formaldehyde gas may be generated by evaporating formalin in a vessel over a lamp, or other form of heating apparatus.

Harrington states that the evaporation of 110 cc. of formalin is sufficient to kill all pathogenic micro-organisms within 2½ hours, in 1,000 cubic feet air space. Formaldehyde gas may be liberated most economically by mixing 8 oz. of potassium permanganate with 1 pint of formalin in a galvanized iron pail 12 inches deep and 10 inches in diameter at the bottom and 18 inches at the top. The pail should be placed on sand or in water as much heat is generated and great frothing occurs. This should be only done in deep tin vessels to avoid the effects of great frothing. This quantity of formalin and potassium permanganate is suitable for the

disinfection of 1000 cu. ft. of space, if the air is moist and warm, but if cold and dry this amount will disinfect only half as much space.

A solidified formaldehyde is also on the market to which one need only add hot water, to free the gas. In veterinary disinfection one may spray formalin in five per cent. solution with a force pump all over the floors, walls, fixtures, etc.

Rubber gloves should be used to protect the hands.

Formalin, in ¼ to 2 per cent. solution, is perhaps the most powerful antiseptic that has been used for surgical purposes, but, when used in such strength upon raw surfaces and mucous membranes it produces pain and irritation and coagulates albumin so as to shut off the underlying parts from participating in the antiseptic action. These stronger solutions, although formerly employed for surgical uses, should be confined to skin disinfection or where an escharotic action is desired on sloughing tissues. Ordinarily the strength of an aqueous solution should not exceed 1-2000, or at most 1-1000, for application to raw surfaces or mucous membranes, and even in this dilution applications sometimes produce considerable pain and irritation, and, for this reason, are contraindicted for ordinary surgical use.

Success is reported from the use of formalin on sloughing surfaces of malignant growths and foul ulcers. A 4 per cent. solution is increased to 10 per cent. and finally to pure formalin, the solutions being applied on cotton saturated with the drug and retained on the part for thirty minutes each day. A 5 per cent. solution of formalin is serviceable for sterilizing catheters, instruments and sutures, for the preservation of pathological specimens, for the disinfection of stables, and in the treatment of canker of the feet in horses.

PREPARATIONS.

Hexamethylenamina. Hexamethylenamine. $C_6 H_{12} N_4$. (U. S. P.)
(Urotropin.)

Urotropin occurs in colorless, transparent crystals, soluble in 1.2 parts of water and in 14 parts of alcohol; odorless, of a sweet, afterward bitter taste, and slight alkaline reaction. It is made by combining solutions of ammonia and formaldehyde, and was first introduced into medicine by Nicolaier in 1895. Urotropin appears to be decomposed in the kidneys with the liberation of formaldehyde, and thus disinfects the urinary tract. It is, in fact, considered the best urinary antiseptic in human medicine and has been used with the greatest success in the treatment of all infectious diseases of the urinary passages, especially acute and chronic pyelitis and cystitis. It tends to render normal a putrid urine containing pus or mucus, is a solvent for uric acid and is slightly diuretic. These actions are of value in similar diseases of animals, especially of dogs. The liberation of formaldehyde is favored by an acid urine and with an alkaline urine some agent, as benzoic acid, should also be given.

Very recently it has been shown that urotropin is also eliminated in the bile, pancreatic juice, synovia, cerebro-spinal fluid, and in the saliva and milk of dogs. Also in middle ear mucus. For this reason the drug is now employed to disinfect these parts. After head and spine injuries and in middle ear abscess, septic arthritis and cholecystitis the drug is indicated.

The drug may be given in from 5 to 10 grain doses thrice daily in solution, in canine practice. H. & C. 3 ii.-iv. (8.-15.). It can now be bought more cheaply under its official name than by its trade name, urotropin. In diabetes mellitus of the human urotropin is often beneficial in reducing the loss of glucose in the urine; it should be tried in this disease in dogs.

Glutol (Formalin-Gelatin).

Glutol is a coarse, white powder, without odor or irritating properties, and is prepared by dissolving gelatin in water and drying the solution in formalin vapor. It is a most valuable antiseptic powder in liberating formaldehyde gas in contact with living cells. Glutol forms a scab when dusted over fresh wounds, preventing infection, and is serviceable in the treatment of infected wounds, abscesses, boils (after paracentesis), sinuses and other surgical conditions. It was first brought into use by Dr. C. L. Schleich, in 1896.

Class 7.—Miscellaneous Carbon Compounds.

Acidum Hydrocyanicum Dilutum.
Diluted Hydrocyanic Acid. H C N. (U. S. & B. P.)

Synonym.—Prussic acid, acidum hydrocyanatum, s. borussicum, E.;* acide cyanhydrique, s. hydrocyanique, Fr.; cyanwasserstoffsäure, blausäure, G.

Derivation.—A liquid composed of 2 per cent., by weight, of absolute hydrocyanic acid, and 98 per cent. of water. Obtained by distillation of potassium ferrocyanide, 20; sulphuric acid, 8; and water, 65; into distilled water. The following reaction first occurs: $K_4 Fe C_6 N_6 + 2 H_2 S O_4 = 2 K_2 S O_4 + H_4 Fe C_6 N_6$; then on the application of heat, the hydroferrocyanic acid resulting in the first reaction reacts with the remaining potassium ferrocyanide and sulphuric acid, as follows: $H_4 Fe C_6 N_6 + K_4 Fe C_6 N_6 + H_2 S O_4 = 6 H C N + K_2 S O_4 + K_2 Fe C_6 N_6$).

Diluted hydrocyanic acid can also be made by mixing hydrochloric acid, 5; with distilled water, 55; silver cyanide, 6. Shake together in a glass-stoppered bottle. $Ag C N + H Cl = H C N + Ag Cl$. When the precipitate of silver chloride falls, pour off the clear, supernatant fluid.

* Scheele's prussic acid contains 4 to 5 per cent. of the pure hydrocyanic acid.

Properties.—A clear, colorless liquid, of a characteristic taste and odor, resembling those of bitter almond. It is very unstable and is apt to be inert as obtained from ordinary drug stores. It should be kept in inverted glass-stoppered dark bottles.

Incompatibles.—Salts of iron, copper and silver; sulphides and red mercuric oxide.

Dose.—H. & C., ♏xxi-xl. (1.3-2.6); Sh., ♏x.-xv. (.6-1.); Sw., ♏ii.-v. (.12-.3); D., ♏i.-iii. (.06-.2).

Action External.—Prussic acid is absorbed to some extent through the unbroken skin; paralyzes the peripheral sensory nerves, and acts as a local anæsthetic. If the finger is held over a bottle containing the acid, it soon becomes anesthetized. Upon mucous membranes, or raw surfaces, prussic acid is rapidly absorbed and exhibits its usual constitutional action.

Action Internal.—Alimentary Canal.—Hydrocyanic acid exerts a sedative effect upon the mucous membrane of the stomach and upper portion of the digestive tract. It is absorbed into the blood, but we are ignorant of its fate or mode of elimination.

Blood.—In poisoning, the blood becomes first of a bright arterial hue, and later assumes a dark, venous color. The first condition is due to the fact that the tissues do not absorb oxygen owing to changes in the protoplasm which interfere with cell respiration; probably also in part because the blood is hurried so rapidly through the dilated peripheral vessels that it does not have time to yield up its oxygen. The dark color of the blood is probably owing to asphyxia and accumulation of carbonic dioxide, following the paralytic action of prussic acid upon the respiratory centre. A substance called cyanohemoglobin is formed outside the body by hydrocyanic acid when shaken with blood. The acid appears to deoxydize the normal oxyhemoglobin, and blood thus treated has no ozonizing property. Cyanohemoglobin was thought to account for the action of prussic acid, but it does not exist within the body in the blood of poisoned animals. The red blood corpuscles are altered in shape by the action of prussic acid upon blood withdrawn from the vessels. They generally become rounder, then granular, and finally disintegrate and liquefy. But these changes do not occur in the blood during life. The general action of prussic acid is altogether independent of any influence upon the blood, since the same toxic effect is produced upon the bloodless, or "salt frog" (vessels containing normal salt solution), as upon the normal batrachian.

Nervous System and Muscles.—Prussic acid first stimulates the hind-brain—as shown by convulsions, and excitation of the vagus, respiratory and vasomotor centres—and then paralyzes the whole nervous system. The brain, cord and nerves become paralyzed by

large doses. The convulsions occurring in poisoning are shown by experiments to be due probably to stimulation of the hind-brain, although they have been attributed to altered cerebral circulation and to asphyxia. They are, however, present during that period of poisoning when the blood is of a bright arterial hue. The spinal cord is paralyzed at a period after coma and convulsions have appeared. The peripheral nerves and muscles are paralyzed directly by toxic doses, and not through the mediation of the central nervous apparatus. This is proved by shutting off the blood supply containing the drug, from a frog's leg, and leaving the nervous connections intact, when no effect of prussic acid is observed upon the limb.

Heart and Blood Vessels.—Death sometimes occurs instantaneously from large lethal doses of prussic acid, owing to diastolic arrest of the heart. This action is due probably to paralysis of the heart and also to irritation of the vagus centre. Moderate non-toxic doses stimulate the vagus centre of the medulla, without diminishing the force of the heart. When the vagi are previously divided, this action does not occur, but after large doses slowing of the heart is observed whether the vagi are cut or not; thus showing that the heart muscle is directly influenced. Moderate doses of prussic acid first stimulate, and then depress the vasomotor centre. Arterial pressure is therefore primarily raised considerably, but this is followed by a fall to, or below, the normal.

Toxic doses stimulate the vasomotor centre very briefly, and this action is succeeded by profound depression and paralysis of the centre, accompanied by a great diminution of blood tension.

Respiration.—Inhalation of the pure acid will cause death in a confined atmosphere, and even inhalation of the medicinal solution will induce the physiological symptoms of the drug. The respiratory centre is usually depressed from the beginning, by prussic acid, and the respiratory movements are therefore lessened in frequency throughout the period of its action. Rarely, there is a primary transient stimulation of the centre, so that the breathing is increased in frequency. In the latter stage of poisoning, the breathing is feeble and shallow, and only occur at long intervals. If death does not supervene immediately from diastolic arrest of the heart, it comes on more slowly by asphyxia. The respiratory movements become less frequent and forcible, the animal giving an occasional gasp, until finally the breathing ceases altogether, while the heart continues to beat for a time.

Summary.—Prussic acid in any considerable dose exerts a transient stimulation upon the hind-brain, followed by depression of the brain, spinal cord, nerves, muscles, and the three great medullary

centres controlling the heart, respiration and vessels. Topically applied, hydrocyanic acid also paralyzes nerves and muscles, and acts therapeutically as a local sedative and anæsthetic.

Toxicology.—Prussic acid is one of the most powerful poisons in existence. Death may be instantaneous, or life may be prolonged for over an hour after a lethal dose. More commonly the animal survives for a few minutes, and we observe the following symptoms in dogs: The animal falls, froths at the mouth, the respiration is of a gasping character and occurs at infrequent intervals. There is unconsciousness, the pupils become dilated, there are muscular tremblings and clonic or tonic spasms. Defecation and micturition occur, and erections often ensue in the male. Respiration ceases before the cardiac pulsations.

Three stages may be distinguished in fatal poisoning. First: a very short period elapses before the symptoms appear. There are giddiness, difficult breathing, and slow pulse in this stage. Second: the pupils dilate, vomiting may occur, and the animal utters loud cries. Spasmodic defecation, micturition and erections may be present, with convulsions and unconsciousness. Third: the last stage is characterized by collapse, spasms, general paralysis and death. The subacute form of poisoning may ensue and prove fatal, or, owing to the volatile character of the drug, complete recovery may take place within one-half or three-quarters of an hour. Occasionally dogs continue to be paralyzed for several days and get well. The minimum fatal dose recorded in man is $\frac{1}{10}$ of a grain of pure acid, or about 50 drops of the medicinal solution. Four to five drachms of the diluted acid frequently, but not invariably, cause subacute poisoning and death, in horses, within an hour. One to two drachms of the pharmacopœial preparation usually kills dogs within ten minutes.

Prussic acid is commonly used to destroy the domestic animals, but the subcutaneous injection of strychnine is preferable for the destruction of the smaller animals (p. 371). Two to four drachms of the medicinal acid are to be given to dogs and cats of the ordinary size, and certain, painless, and rapid death will occur if a fresh preparation of the drug can be obtained. The unopened, half-ounce vial, kept by druggists, is recommended. Big dogs, horses, and the other larger animals are not killed rapidly, nor sometimes at all, by great quantities of the diluted acid. Hence, shooting is a more humane and preferable mode of death for them. In the experience of the writer, one to two drachms of prussic acid saturated with potassium cyanide, failed to kill a horse, when injected directly into the jugular vein. The odor of the acid lingers about the animal for a few hours after death; the eyes are fixed and staring; the

pupils dilated; the teeth are clinched tight and covered with froth, while the blood is of a very dark color. The treatment embraces emptying the stomach by large doses of promptly acting emetics, or by the stomach tube, or pump; atropine, ether and brandy subcutaneously, and inhalations of ammonia, together with artificial respiration, and hot and cold douches upon the chest.

Uses.—Prussic acid is indicated for three therapeutic purposes:

1. To relieve gastric pain and vomiting, by its paralyzing action upon the peripheral sensory nerves of the stomach.

2. To stop coughing.

3. To allay itching by means of its local, sedative action upon the cutaneous sensory nerve-endings.

As a medicine it is not of much value, but is used in veterinary practice as a cough remedy, when the symptom is of reflex origin, or is caused by chronic or verminous bronchitis; and the acid is often conjoined with chloroform, or opium, in some form. In verminous bronchitis the medicinal acid may be given by inhalation (3 ss. in ℥ i. of water) to calves, or internally (♏xv.) to assuage coughing and to kill the strongyles. Prussic acid is a dangerous remedy for use in relieving itching unless the dose is carefully regulated. Ten minims of the acid, with gr. ¼ of corrosive sublimate to the ounce of water, is efficient in pruritus in the larger animals in amounts not larger than this for single applications, and not larger than half this for the smaller patients.

Potassii Cyanidum. Potassium Cyanide. K C N.
(U. S. & B. P.)

Synonym.—Cyanure de potassium, Fr.; cyankalium, G.

Derivation.—Made by heating together potassium ferrocyanide and carbonate.

Properties.—White, opaque, amorphous pieces; or a white, granular powder, odorless when perfectly dry, but in moist air exhaling the odor of hydrocyanic acid. Taste sharp and alkaline, and in moist air the salt deliquesces. Reaction very strongly alkaline. Solutions stain and destroy clothing. Soluble in about 2 parts of water; sparingly soluble in alcohol.

Dose.—H., gr.i.-ii. (.06-.12); D., gr. 1/10 (.006).

Action and Uses.—Potassium cyanide is transformed, in the stomach and blood, into prussic acid, and resembles the latter in its action, but is much slower. Death has been caused in man by 5 grains of the salt.

ARGENTI CYANIDUM. Silver Cyanide. Ag C N. (U. S. P.)

A white, insoluble, tasteless, odorless powder, used for making prussic acid.

PRUNUS VIRGINIANA. Wild Cherry. (U. S. P.)

Synonym.—Ecorce de cerisier de Virginie, Fr.; wildkirschen-rinde, G.

The bark of the wild cherry, indigenous in the United States, contains a ferment (emulsin) which, in the presence of water, acts on a glucoside (amygdalin, C_{20} H_{27} N O_{11}) contained in the bark, with the formation of hydrocyanic acid, glucose and a volatile oil. A fluidextract, infusion and syrup of prunus virginiana are official. The latter preparation is sometimes employed in cough mixtures for dogs, on account of its sedative action. The entire value of the drug depends upon the minute amount of prussic acid formed in it. The official hydrocyanic acid is more reliable, but syrupus pruni virginianæ (U. S. P.) may be used as a vehicle for more efficient remedies.

PETROLATUM. (U. S. P.)

(Three varieties.)

1.—PETROLATUM LIQUIDUM. Liquid Petrolatum. (U. S. P.)

Derivation.—A mixture of hydrocarbons, chiefly of the marsh-gas series, obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue when it has the desired consistence.

Properties.—A colorless, or more or less yellowish, oily, transparent liquid, without odor or taste; or giving off, when heated, a faint odor of petroleum. Spec. gr. about 0.875—0.945. Insoluble in water; scarcely soluble in cold or hot alcohol, or cold absolute alcohol; but soluble in boiling absolute alcohol, and readily soluble in ether, chloroform, carbon disulphide, oil of turpentine, benzin, benzol, and fixed and volatile oils.

2.—PETROLATUM.* Petrolatum. (U. S. P.)

Synonym.—Vaseline, cosmoline.

Derivation.—A mixture of hydrocarbons, chiefly of the marsh-

* The 1905 edition of the U. S. P. does not now recognize, as formerly, the varieties Petrolatum Molle and Spissum.

gas series, obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue when it has reached the desired melting point.

Properties.—A fat-like mass of about the consistence of an ointment, varying in color from yellowish to light amber, having not more than a slight fluorescence, even after being melted; transparent in thin layers, completely amorphous, and without odor or taste; or giving off, when heated, a faint odor of petroleum.

The melting point of petrolatum ranges between 45° and 48° C. (113° and 118.4° F.). In other respects soft petrolatum has the solubility of liquid petrolatum.

3.—Petrolatum Album. White Petrolatum.

A colorless mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off the lighter and more volatile portions from petroleum, and purifying the residue. A white, unctuous mass, of about the consistency of an ointment, transparent in thin layers, completely amorphous; without odor or taste. Otherwise it resembles, in solubility, petrolatum.

Action and Uses.—Petrolatum is a valuable emollient. It soothes, protects and softens parts to which it is applied, and is superior to animal and vegetable fats and oils in not becoming rancid, and therefore irritant and malodorous. Petrolatum may be used alone, or as an excipient in the preparation of ointments, but does not aid the absorption of drugs (as do alcohol, glycerin, chloroform, and animal oils and fats), for it is not itself absorbed even when administered internally. Petrolatum exerts a demulcent action upon the mucous membrane of the alimentary tract, and may be prescribed in electuary or capsule in inflammation thereof. Liquid petrolatum is useful given internally in piles (D. ℥ ss. twice daily) to soften the feces. It is also very seviceable with menthol and camphor (aa gr. xv. to ℥ i.) dropped in the nostrils (with a medicine dropper) for dogs with coryza. Petrolatum is sold universally under the proprietary names of vaseline and cosmoline, and is often combined with antiseptics for medicinal and surgical purposes in skin diseases and upon inflamed mucous membranes, blistered and abraded surfaces and sores. It is one of the most useful agents in lubricating instruments, protecting metal from rust, preserving leather, and is sometimes employed as a vehicle for electuaries.

Rhigolene. (Non-official.)

Rhigolene is a petroleum product prepared by repeated distilla-

tion until the liquid boils at 64.4° F. It evaporates at a lower temperature than any other substance, except cymogene, and is employed as a spray to induce numbness and local anæsthesia of a part in minor surgical operations, such as paracentesis of an abscess or the use of the actual cautery.

Aethylis Chloridum. (U. S. P.) $C_2 H_5 Cl$.

Ethyl chloride is in more common use for the same purposes. It is a colorless, mobile, very volatile liquid; slightly soluble in water but readily soluble in alcohol. It is made by the action of HCl gas upon absolute ethyl alcohol. It is usually sold in glass tubes with a screw or lever-spring metal top enabling the fluid to be sprayed upon the surface of the body in any desired amount.

On account of its great volatility and rapid evaporation it abstracts heat and freezes a part, and so acts as a local anæsthetic. It is convenient for minor surgical operations, as opening abscess or boil, or for aspiration. The vapor is very inflammable. Ethyl chloride is also used to produce transient, general anæsthesia. 1 or 2 drachms may be used for dogs. It is exceedingly rapid in its effects and a safe anæsthetic for short periods. It is sprayed into the neck of a funnel, the large end being partly filled with absorbent cotton and held tightly over the nose. Recovery is also extremely rapid. Ethyl chloride is often sold under the name of "kelene." It is used frequently as a preliminary to ether in human practice and is more agreeable to inhale. Plenty of air should be allowed, except at the outset.

PART II.

VEGETABLE DRUGS.

SECTION I.—DRUGS ACTING UPON THE BRAIN.

Opium. Opium. (U. S. & B. P.)

Derivation.—The concrete, milky exudation obtained by incising the unripe capsules of Papaver somniferum Linné (Nat. ord. Papaveraceæ), and yielding in its normal, moist condition, not less than 9 per cent. of crystallized morphine, when assayed by the official process (U. S. P.) Opium is procured from Turkey, Asia Minor, Persia, India and Egypt. The Smyrna, or Turkey opium is the more common variety used in the United States. It occurs in irregular, globular masses, covered with poppy leaves and capsules of a species of dock, weighing from ½ to 1 pound.

Properties.—In irregular, flattened, more or less rounded masses of variable size, externally grayish-brown, covered with remnants of poppy leaves and with occasional fruits of a species of *Rumex;* more or less plastic when fresh, but becoming hard on keeping; internally dark brown, somewhat lustrous; odor strong, narcotic; taste bitter and characteristic. It yields its medicinal properties to water, alcohol, and diluted acids, forming dark brown solutions. Ether extracts its principles in part.

Constituents.—There are nineteen or more alkaloids; the three first are used in human medicine, but narceine is of no value in veterinary medicine.

Morphine.	2.5—22 S per cent.	Thebaine.	.15— 1. per cent.
Codeine.	.2— .7 " "	Narcotine.	1.3 —10. " "
Narceine.	.1— .7 " "	Papaverine.	1. " "

In addition to these, the following exist in minute quantity, but some are merely "pharmaceutical curiosities":—

Protopine.		*Organic Acids.*	
Cryptopine.		Meconic Acid.	
Oxynarcotine.		Lactic Acid.	
Hydronarcotine.		Pectin.	
Laudanosine.		Gum.	50. per cent.
Laudaine.		Resin.	
Phœadine.		Glucose.	
Codamine.		Fixed Oils.	
Meconodine.		A Volatile Oil.	
Gnoscopine.		Odorous Bodies.	
Lanthopine.		Caoutchouc.	
Water.	15.—25. per cent.	Ammonium Salts.	
Neutral Bodies.		Calcium Salts.	
Meconin.		Magnesium Salts.	
Meconoisin.			

Impurities.—Starch, molasses, leaves, fruit, stones and water.

Incompatibility.—Solutions of lead acetate and subacetate, and of copper and arsenic salts, precipitate meconates, sulphates and coloring matters, but the opium remains physiologically active. Ferric chloride produces a deep red color with opium, by its union with meconic acid. Tannin compounds precipitate codeine tannate. Alkalies, their carbonates and ammonia precipitate morphine and narcotine.

Dose.—H., ʒ i.-ii. (4.-8.); C., ʒ ii.-iv. (8.-15.); Sh., gr.x.-xxx. (.6-2.); Sw., gr.v.-xx. (.3-1.3); D., gr.ss.-iii. (.03.2).

Opii Pulvis. Powdered Opium. (U. S. P.)

Opium dried at a temperature not exceeding 85° C. (185° F.), and reduced to a fine powder. Powdered opium, for pharmaceutical or medicinal purposes, when assayed should yield not less than twelve (12) nor more than twelve and a half (12.5) per cent. of crystallized morphine. Any powdered opium of a higher percentage may be brought within these limits by admixture with powdered opium of a lower percentage in proper proportions. Only those are mentioned here which are applicable to veterinary practice.

Dose.—Same as for opium, but preferable to the crude drug.

PREPARATIONS.

Extractum Opii. Extract of Opium. (U. S. & B. P.)

Powdered opium, 100; distilled water, 1000; sugar of milk, a sufficient quantity. Made by trituration, filtration, and evaporation. Assayed to contain 20 per cent. of morphine. (U. S. P.)

Dose.—About one-half that of powdered opium. H., 3 ss.-i. (2.-4.); C., 3 i.-ii. (4.-8.); Sh., gr.v.-xv. (.3-1.); Sw., gr.ii.ss.-x. (.15-.6); D., gr.¼-i.ss. (.015-.09).

Pulvis Ipecachuanhæ et Opii. Powder of Ipecac and Opium. (U. S. P.)

Synonym.—Dover's powder, E.; pulvis ipecacuanhæ opiatus, s. pulvis Doweri, P. G.; poudre de Dower, Fr.; Dower'sches pulver, G.

Ipecac, 10; powdered opium, 10; sugar of milk, 80. The most diarphoretic compound of opium.

Dose.—H., ʒ ss.-i. (15.-30.); D., gr.iii.-xv. (.2-1.).

Tinctura Ipecacuanhæ et Opii. Tincture of Ipecac and Opium. (U. S. P.)

Synonym.—Liquid Dover's powder.

Tincture of deodorized opium, 1000; fluid extract of ipecac, 100; diluted alcohol, a sufficient quantity to make 1000. Made by evaporation and filtration.

Dose.—Same as Dover's powder.

Tinctura Opii. Tincture of Opium. (U. S. & B. P.)

Synonym.—Laudanum, tinctura meconii, tinctura thebaicæ, E.; tinctura opii simplex, P. G.; teinture d'opium, teinture thébaïque, Fr.; einfache opiumtinktur, G.

Granulated opium, 100; alcohol, 400; water, 400; diluted alcohol to make 1000. Made by trituration, maceration with precipitated calcium phosphate, and percolation. Assayed and standardized to contain between 1.2 and 1.25 gm. of morphine in 100 c.c. (U. S. P.)

Dose.—H., ʒ i.-ii. (30.-60.); C., ʒ ii.-iii. (60.-90.); Sh. & Sw., 3 ii.-vi. (8.-24.); D., ♏iii.-xx. (2-1.3.).

Tinctura Opii Camphorata. Camphorated Tincture of Opium. (U. S. P.)

Synonym.—Tinctura camphoræ composita, B. P.; paregoric, elixir paregoricum, paregoric elixir, E.; tinctura opii benzoica, P. G.; élixir parégorique, Fr.; benzöesaurehaltige opiumtinktur, G.

Powdered opium, 4; benzoic acid, 4; camphor, 4; oil of anise, 4; glycerin, 40; diluted alcohol to make 1000. Made by maceration and filtration. (U. S. P.)

Dose.—D., 3 i.-iv. (4.-15.).

Opium Deodoratum. Deodorized Opium. (U. S. P.)

Synonym.—Opium denarcotizatum.

Powdered opium (containing 12–12.5 per cent. of morphine), 500; purified petroleum benzin, q. s. Made by repeated maceration, agitation and percolation

with purified petroleum benzin. The petroleum benzin removes narcotic and odorous principles, which cause nausea and disagreeable after-effects in opium. Contains 12–12.5 per cent. of morphine.

Dose.—Same as powdered opium.

The eighth (last) edition of the U. S. P. has introduced *Opium Granulatum* (granulated opium); made by drying opium at a temperature not exceeding 85° C. (185° F.) and reducing it to a coarse (No. 20) powder. It should not yield less than 12 nor more than 12.5 per cent. of crystallized morphine. Dose, same as deodorized opium.

Tinctura Opii Deodorata. Tincture of Deodorized Opium. (U. S. P.)

Granulated opium, 100; purified petroleum benzin, 75; alcohol, 200; water to make 1000. Made by percolation with water, agitation with purified petroleum benzin, and evaporation. Assayed and standardized to contain between 1.2 and 1.25 gm. of morphine in 100 c.c.

Dose.—Same as tincture of opium, but less nauseating.

Extractum Opii Liquidum. (B. P.)

(Contains ¾ per cent. of morphine.)

Dose.—Same as laudanum.

Vinum Opii. (U. S. P.)

Dose.—Same as laudanum.

Morphina. Morphine. $C_{17}\ H_{19}\ N\ O_3 + H_2\ O$. (U. S. & B. P.)

Derivation.—An alkaloid obtained from opium.

1. Macerate opium in cold water, forming a solution of morphine meconate. 2. Add calcium chloride to precipitate calcium meconate and resins. 3. Evaporate solution remaining, which contains morphine hydrochlorate, till it crystallizes; press in flannel to remove narcotine and coloring matter; redissolve; filter; evaporate and crystallize repeatedly. 4. Decolorize by digestion with charcoal. 5. Precipitate with ammonia and wash, when pure morphine is separated from codeine.

Properties.—Colorless or white, shining prismatic crystals, or fine needles, or crystalline powder; odorless and having a bitter taste; permanent in the air; soluble in 3330 parts of water.

Dose.—Same as salts of morphine, but the latter are preferable on account of their solubility.

Morphinæ Hydrochloridum. Morphine Hydrochloride. $C_{17}H_{19}N\ O_3H\ Cl + 3\ H_2O$. (U. S. & B. P.)

Derivation.—Morphine is stirred with hot distilled water, to

which hydrochloric acid is gradually added. Morphine hydrochlorate crystallizes out on cooling.

Properties.—White, silky, glistening needles or microcrystalline cubes, or a white, crystalline powder, odorless, and having a bitter taste; permanent in the air. It loses its water of crystallization at 100° C. (212° F.). Soluble in in 17.2 parts of water, and in 42 parts of alcohol at 25° C. (77° F.); soluble in 0.5 part of water at 80° C. (176° F.), and in 35.5 parts of alcohol at 60° C. (140° F.); insoluble in ether and in chloroform.

Incompatibility.—Incompatible with all agents containing tannin, alkaline carbonates, lime water, salts of copper, mercury, zinc and lead; and with Fowler's solution of arsenic.

Dose.—H. & C., gr.iii.-x. (.2-.6); Sh., gr.ss.-ii. (.03-.12); Sw., gr. $\frac{1}{10}$-$\frac{1}{2}$ (.006-.03); D., gr. $\frac{1}{8}$-$\frac{1}{2}$ (.008-.03).

Subcutaneously.—H., gr.iii.-iv. (.2-.24); D., gr. $\frac{1}{8}$-$\frac{1}{2}$ (.008-.03).

124 parts of morphine hydrochloride correspond to 100 parts of morphine.

Morphinæ Acetas. Morphine Acetate.

$C_{17}H_{19}N\,O_3C_2H_4O_2 + 3\,H_2O$. (U. S. & B. P.)

Derivation.—Morphine is dissolved in acetic acid and water, and the solution evaporated and crystallized.

Properties.—A white, or faintly yellowish-white, crystalline, amorphous powder, having a faint, acetous odor and bitter taste. It slowly loses acetic acid on exposure to the air, and should be kept in dark, amber-colored, well-stoppered vials. Soluble, when freshly prepared, in 2.25 parts of water, and in 21.6 parts of alcohol.

Dose.—Same as morphine hydrochloride.

Morphinæ Sulphas. Morphine Sulphate.

$(C_{17}H_{19}N\,O_3)_2\,H_2S\,O_4 + 5\,H_2O$. (U. S. & B. P.)

Derivation.—Morphine is stirred into boiling distilled water; diluted sulphuric acid is added until neutralization is attained, and the sulphate crystallizes out on cooling.

Properties.—White, feathery, acicular, silky crystals, or in cubical masses, odorless, permanent in the air, and having a bitter taste. It loses three molecules of water of crystallization at 100° C. (212° F.), and the remaining two at 130° C. (266° F.). Soluble in 15.3 parts of water, and in 465 parts of alcohol at 25° C. (77° F.); soluble in 0.6 part of water at 80° C. (176° F.), and in

187 parts of alcohol at 60° C. (140° F.); insoluble in ether and chloroform.

Dose.—Same as hydrochloride. 125 parts of morphine sulphate correspond to 100 parts of the pure alkaloid.

The official salts of morphine may be used interchangeably. The acetate is more soluble, but less stable, than the sulphate, which is sufficiently soluble for practical purposes, and is in more common use.

Liquor Morphinæ Hydrochloridi. (B. P.)
One per cent.

Dose.—H., ʒ vi.-ʒ ii. (24.-60.); D., ♏x.-ʒ i. (.6-4.).

Liquor Morphinæ Acetatis. (B. P.)

Same strength and dose as above.

Injectio Morphinæ Hypodermica. (B. P.)
One per cent.

Dose.—Same as liquor morphini hydrochloridi.

Suppositoria Morphinæ. (B. P.)
(Gr. ½ morphine.)

Dose.—Dog, 1 per rectum.

Codeina. Codeine. $C_{18}H_{21}NO_3 + H_2O$. (U. S. & B. P.)

Derivation.—An alkaloid obtained from opium by evaporation of the ammoniacal liquid, after the precipitation of morphine. The residue is added to water, precipitated by potassium hydrate, and redissolved in ether, from which codeine crystallizes out on evaporation.

Properties.—White, or nearly translucent, orthorhombic prisms, octahedral crystals, or a crystalline powder; odorless, and having a faintly bitter taste; slightly efflorescent in warm air. Soluble in 88 parts of water, 1.6 parts of alcohol, 12.5 parts of ether, and 0.66 part of chloroform at 25° C. (77° F.); soluble in 59 parts of water at 80° C. (176° F.), and in 0.92 part of alcohol at 60° C. (140° F.).

Dose.—D., gr. ¼-ii. (.015-.12).

Heroin.

(Diacetylmorphine.)

This remedy, derived from morphine, was first introduced by Dreser, in 1898, and is now used extensively in human medicine as a substitute for morphine and codeine. Heroin occurs as a white, odorless, crystalline powder, possessing a slightly bitter taste and alkaline reaction. Practically insoluble in water, but readily soluble in weak acidulous solutions.

Heroin hydrochloride is a white, crystalline, odorless powder, soluble in 2 parts of water. Heroin surpasses both morphine and codein therapeutically in many ways. It increases markedly the inspiratory and expiratory force, while lessening the number of the respiratory movements, and exerts a special sedative influence on the respiratory mucous membranes. The drug acts also as a general motor depressant, hypnotic and analgesic, but is not comparable to morphine in these respects. Heroin is said to be five times more toxic for dogs than morphine. The after-effects of small medicinal doses (nausea, constipation, etc.) are slight. Heroin is particularly valuable in the treatment of all varieties of cough affecting the human subject, and should prove useful in canine practice.

Heroin may be administered in powder, pill or tablet, the hydrochloride in solution, every few hours.

The dose of either is, for the dog, gr. $\frac{1}{24}$-$\frac{1}{6}$ (.0025-.01).

Opium and Morphine.

The action of morphine and opium is practically the same, with some exceptions to be noted.

Action External.—Opium may be absorbed to a slight extent from the unbroken skin, and causes a mild, anodyne action. Absorption readily occurs from mucous membranes and raw surfaces, with resulting characteristic effects.

Action Internal.—Digestive Tract.—Opium diminishes the two principal activities of the digestive organs, namely, secretion and motion. Secretions all over the body are decreased, except that of sweat. The action upon the alimentary tract in lessening secretion, is partly a local one and partly constitutional, following the absorption of the drug. The mouth is made dry, thirst is increased and appetite impaired. Opium is absorbed rather slowly from the stomach and bowels, and stimulates the splanchnic nerve centre of the sympathetic system, which inhibits the movements of the stomach and intestines, and thus lessens peristaltic action of these organs.

Opium is directly opposed to belladonna in this respect, as the latter drug paralyzes the intestinal inhibitory apparatus (splanchnic endings), and so increases peristalsis.

In diminishing both secretion and motion, opium causes constipation in health, but is most useful in relieving vomiting and diarrhœa. In toxic doses, opium may induce diarrhœa from paralysis of the splanchnic inhibitory centre.

Blood and Elimination.—Morphine circulates in the blood as such. The greater part of opium is decomposed in the body, a portion being destroyed by the liver, while some is probably burned up in the blood. The smaller part is eliminated, chiefly by the kidneys, but also in the other secretions. It is found in the gastric juice after hypodermic injection, and therefore washing out the stomach assists elimination and recovery in opium poisoning.

Nervous System.—The most important action of opium is exerted upon the nervous system. It is necessary to study the drug from the comparative standpoint in order to obtain a full understanding of its effects. The brain of man, being more highly developed and sensitive, in comparison with other parts of the nervous system, than the brain of the lower animals, it follows that this organ is more powerfully influenced in man, while the spinal cord is often mainly impressed in the lower animals.

We may take the action of opium on the frog, at one end of the scale, as exhibiting the most active spinal symptoms; while in man, at the other end of the scale, cerebral phenomena predominate. The other animals occupy an intermediate position; the action upon the horse and ruminants is something between that exerted upon the frog and man, and the influence upon dogs approaches more nearly that seen in human beings, only that a relatively greater dose is required to produce the same result, as the brain is not so highly organized or sensitive to the action of medicines. The brain of the horse is only one-twelfth as large as that of man, in proportion to their respective body weights, and it follows that the spinal cord of the horse is more readily affected by opium, in accordance with the general law that the more highly developed a part is, the more easily is it influenced by therapeutic agents.

Opium exerts first a stimulating, and then a depressing action upon the brain and spinal cord, and in studying the action comparatively it will be noted that the influence upon the cord in the frog, horse, ruminant, and to some extent in the dog, preponderates frequently over the effect of the drug upon the brain, for the reasons stated above.

Action on the Frog.—In non-poisonous doses, sleep is produced and diminished spinal reflex activity, followed by a period of

reflex excitement. Toxic doses of 1 or 2 grains of morphine, injected under the skin, causes at first a condition where convulsions occur, if the animal is artificially irritated; later they come on spontaneously. This state is followed by general paralysis, respiratory failure and death. The convulsions are shown to be due mainly to stimulation of the receptive and transmitting cells of the spinal cord, as in strychnine poisoning.

Action on Horses.—Three grains of morphine, injected subcutaneously, occasion sometimes drowsiness, and at other times produce no visible effect. Four to six grains, given in the same way, cause restlessness, a rapid pulse, and moisture of the skin. The animal paws the ground and walks in a rhythmical manner about the stall. The pupils are dilated. Large doses (12 grains) are followed by increased excitement aggravated by noises, sweating, ptyalism, muscular rigidity, staggering gait, trembling and delirium; while still larger doses (four drachms of the extract of opium) cause violent trembling, convulsions, insensibility to pain and external irritation, without coma; or (morphine, gr. 36 under the skin), rarely, stupor for several hours (3 hours), dilated pupils and blindness, followed by delirium and restlessness, continuing for a longer time (7 hours) and ending in recovery. Horses have recovered from an ounce of opium, but 2½ ounces of the drug, and 100 grains of morphine have proved fatal. The action of opium upon the horse differs from that upon man and dogs in the more frequent occurrence of restlessness and motor excitement due to stimulation of the cerebral and spinal motor centres; and in dilatation instead of contraction of the pupil. The rationale of the latter phenomenon has not been discovered.

Action on Ruminants.—These animals are comparatively insusceptible to opium. Ounce doses of the drug cause, in cattle, restlessness, excitement, hoarse bellowing, dry mouth, nausea, indigestion and tympanites. Sheep are affected in much the same manner. One to two drachms of morphine have led to fatality in cattle. Fifteen to thirty grains of the alkaloid comprise a lethal dose for sheep. Swine are variously influenced; sometimes excited, sometimes dull and drowsy.

Action on Birds.—Birds, as represented by chickens, ducks and pigeons, are exceedingly insusceptible to opium. This is chiefly due to the slow absorption from the crop. Pigeons cannot be given enough opium by the mouth to cause death, but 8 to 10 grs. of morphine per orem, or 2 or 3 grs. hypodermatically, will prove fatal. The toxic symptoms in birds are exhibited by unsteadiness, difficult breathing and failure of respiration, convulsions and death. The pupils are unaffected, and sleep does not ensue.

Action on Dogs.—When 8 or 10 grains of morphine are given to a moderate sized dog, coma comes on, from which the animal may recover. One half a grain injected under the skin of a dog weighing 25 lbs., causes nausea, vomiting and perhaps purging, sleep deepening into coma, contracted pupils, and shallow breathing; the condition lasting for several hours and followed by recovery. Opium rarely exerts an hypnotic action upon cats, but rather motor excitement. Lethal doses (average, ⅙ grain of morphine sulphate subcutaneously to the 2.2 pounds, live weight, for dogs; 2 to 3 grains sometimes kill small dogs), increase the frequency of the pulse, cause vomiting, unsteadiness, contracted pupils, motor excitement, as twitching of the limbs, followed by coma, respiratory failure and death. Recovery from full doses of opium is accompanied in dogs by general physical and mental depression and lassitude, as in man. There are muscular weakness, loss of natural spirit, timidity, and nausea, lasting for several hours. The action of opium on dogs differs from that on man only in degree. The dose required is proportionately larger. There is often more preliminary excitement and symptoms of reflex irritation, as muscular twitching. These animals do not sweat, and the pupils are not so continuously contracted in poisoning. Failure of the drug to produce sleep, and the presence of nausea, retching, dreams, delirium, hallucinations, occasionally observed in dogs, are common to man. Convulsions rarely occur in either men or dogs.

Action on Man.—In man, a small dose of morphine (⅛ gr.) causes usually a sense of well-being, together with itching of the nose, and later, of the skin generally, dryness of the mouth (occasionally there may be nausea, vomiting and faintness), followed by sleep, or a pleasant, dreamy state. After-effects may be absent, or consist of nausea, headache, coated tongue and constipation. If the dose is larger, sleep comes on quickly, the pupils are contracted, the respiratory movements and pulse become slow, and the skin is moist.

With lethal doses, sleep deepens into coma, from which the patient can at first be aroused; the coma becomes profound, the pulse feeble and rapid, the respiration stertorous, slow and imperfect. The mucous membranes are cyanotic, the face livid, the pupils dilate, and the surface is covered with clammy sweat. Death occurs from respiratory failure, occasionally preceded by convulsions. One-eighth of one grain of morphine subcutaneously is the smallest fatal human dose recorded. (Average dose for man, gr. ¼.) The action of opium upon man, as compared with that upon the horse and ruminants, is characterized by its predominant depressing effect upon the higher mental functions. The motor centres of the brain and cord are only slightly influenced.

General Action of Opium Upon the Nervous System.—The action of opium on the nervous system may be summarized as follows:

1. *On the Cerebrum.*—The predominant action of opium on man and the dog consists in depression of the higher brain centres with the production of nervous sedation and sleep. In the hind-brain depression of the perceptive centres gives relief from pain. In the fore-brain depression of the centres for intellect—especially of will and attention—causes sleep. The middle or motor area of the brain is commonly not affected until paralyzed in fatal poisoning. In horses and cats, however, toxic doses do stimulate the cerebral motor centres. A primary stimulant stage in the action of opium on the brain of man is sometimes evident.

In this there is a feeling of well-being and enhanced mental powers. But the stimulation is brief and rarely uniform, imagination being increased at the expense of reason and judgment. This stage is often wholly absent. In the lower animals—other than dogs—the sedative and hypnotic effect of opium is less certain and may be completely wanting.

In a general way small and moderate doses cause cerebral depression, while large doses give rise to spinal reflex excitability in the lower animals—especially in the horse, ass, cattle and cats.

2. *On the Spinal Cord.*—Small medicinal doses depress the motor cells, but large and toxic amounts stimulate the motor cells indirectly and cause convulsions—probably—as in strychnine poisoning—by increasing the activity of the receptive and transmitting cells of the cord.

Convulsions, caused by spinal and cerebral motor stimulation, rarely occur in man or dogs but are common after toxic amounts in horses, cattle and cats. The result of a fatal dose is paralysis of the central nervous system, including the respiratory and, to much less degree, the vagus and inhibitory centres.

The unique and inestimable value of opium depends upon its anodyne action. Relief from suffering is often induced without the production of sleep.

Muscular weakness is present in man and dogs, but even this evidence of depression may be absent in horses and ruminants, yet pain be effectually relieved.

Initial stimulation of the vomiting centre may cause emesis; but, as depression of the centre rapidly ensues, the act becomes later improbable. The excitability of the motor and sensory nerves is slightly increased, but otherwise the nerves are not affected except in poisoning, when the sensory, and later the motor nerves are paralyzed. The muscles remain uninfluenced.

Respiration.—Opium does not influence the respiratory functions in small therapeutic doses, but large doses make the respiratory movements slower and feebler, and death occurs from the direct depressing and paralyzing action of the drug upon the respiratory centres in the medulla.

Circulation.—Small doses commonly produce little effect upon the heart. Large doses first increase the force and then slow the heart's action, while toxic quantities depress the organ. The cardiac muscle is primarily stimulated, with acceleration of the pulse, but depression soon follows more or less synchronously with stimulation of the vagus centre and endings, so that the pulse becomes infrequent. Finally, before death, depression of the inhibitory apparatus occurs, and this, coexisting with depression of the heart itself, produces a feeble, rapid pulse, characteristic of the last stage of opium poisoning. Death occurs with diastolic arrest of the heart owing to failure of the cardiac muscle, although fatality is mainly due to the more powerful effect of the drug upon the respiratory centre.

The action of opium upon the vasomotor system is unimportant. Immediately after the administration of large doses there is a slight primary stimulation, followed in the toxic stage by some depression of the vasomotor centres in the spinal cord and medulla.

Pupil.—The pupil of the horse is widely dilated by large doses of opium. The pupil in the dog occasionally remains unchanged, and often dilated before undergoing contraction. Contraction of the pupil is a characteristic physiological effect of large doses of opium in man and the dog. In birds the pupil is unaffected. These various contradictory phenomena are at present inexplicable.

In man, contraction of the pupil is brought about by stimulation of the pupillary centre in the floor of the aqueduct of Sylvius and, through it, the oculomotor nerves. Dilatation, preceding death, occurs from depression of the centre.

Kidneys and Metabolism.—The excretion of urea appears to be diminished by opium in man, but varies greatly in animals. Temporary retention of urine may follow the administration of a considerable dose of opium, owing to diminished sensibility of the bladder. The amount of urine voided may be greater or less than normal; more commonly the latter. Opium lessens the secretion of bile.

The elimination of carbonic dioxide is diminished by the hypnotic action of opium, but is increased if there is general excitement and muscular activity following the use of the drug.

Skin.—Opium induces mild diarphoresis in man; occasionally sweating occurs in horses, but not at all in dogs.

Temperature.—The bodily temperature may be slightly in-

creased by large medicinal doses of opium, but is diminished by toxic quantities.

Toxicology.—The symptoms of poisoning have already been sufficiently described in previous sections. The treatment embraces irrigation of the stomach, or the use of emetics, as apomorphine hydrochlorate under the skin, and the subcutaneous injection of strychnine, enemata of hot, strong, black coffee; leading the animal about, slapping him, or using the faradic current. Dr. Moor, of New York, has apparently found in potassium permanganate the most efficient antidote for opium and morphine. Ten to fifteen grains, dissolved in eight ounces of water, should be given by the mouth, to large dogs. One to two drachms of potassium permanganate may be administered to horses in two or three pints of water. Permanganate solution oxidizes and destroys morphine, and should be acidulated with a little vinegar or diluted sulphuric acid, after the ingestion of morphine salts. The antidote has been recommended to be given subcutaneously after absorption, or hypodermic injection of morphine, but this is not of the slightest use.

Morphine Contrasted with Opium.—Opium is more constipating, more sudorific, and more apt to disturb the digestion than morphine. Morphine is more anodyne and soporific; more readily absorbed and more suitable for use under the skin.

Synergists.—Belladonna aids the action of opium and yet is antagonistic to it. It assists opium in its anodyne action and lessens nausea, indigestion, and constipation following the action of the latter drug. Belladonna and atropine are antagonistic to opium in stimulating the brain and respiration, and increasing peristalsis. Small doses of belladonna combined with opium do not interfere with the soporific action of the latter, notwithstanding the exciting influence of the former upon the brain. The bromides also promote the sedative and hypnotic action of opium, and lessen the depression and nausea following its administration. Opium often acts profoundly when combined with chloral, and this combination is occasionally used to induce anæsthesia (p. 292). Chloroform and ether are frequently prescribed with opium to secure an additional antispasmodic and anodyne action in colic. The astringents and mineral acids enhance the effect of opium in diarrhœal disorders.

Codeine.—Codeine in large doses causes motor excitement and convulsions in dogs and cats, but physiological experiments conducted by various observers have otherwise yielded diverse results. This is explicable, since so-called codeine is frequently in part morphine. Codeine is inferior to morphine as an anodyne and hypnotic, but is a useful sedative in relieving bronchial irritation and cough, and in the doses commonly employed does not induce indi-

gestion, nausea or constipation. The writer would particularly recommend it for dogs suffering with bronchitis, combined with phenacetin in powder or tablet. The other alkaloids of opium are not of sufficient therapeutic value to warrant their consideration in this work.

Administration.—Morphine sulphate is employed under the skin where an immediate effect is required. The preparations more frequently used in veterinary practice include laudanum and the deodorized tincture, powdered opium, extract of opium, and the salts of morphine. One-quarter grain of the latter is equivalent to one grain of opium. Paregoric is useful in canine practice for cough mixtures. Dover's powder combines the expectorant and diaphoretic action of ipecac with the sedative, antiphlogistic and sudorific influence of opium, but the former drug has little effect upon the horse. The preparation may be serviceable, however, in the first stage of catarrhal affections of the respiratory tract in dogs.

Fluid preparations are generally desirable in securing more rapid absorption, but opium produces the best result in diarrhea, when given in pill or ball. Enemata composed of thin, boiled starch solution and laudanum at the body temperature are to be recommended in diarrhea of the young, dysentery and pain arising from strangury or disease of the genito-urinary organs. Opium suppositories are of value in canine practice for the same purposes, and will relieve irritation and pain caused by piles.

Uses External.—Opium is applied externally in various ways. In the form of laudanum it is sprinkled on poultices and prescribed in liniment (laudanum and soap liniment, equal parts) for its anodyne action, but has probably little medicinal virtue upon the unbroken skin. On raw surfaces, sores and ulcers, opium does relieve pain, and for this purpose laudanum may be conjoined advantageously with lead water (1-25).

INDICATIONS FOR THE INTERNAL USE OF OPIUM.

1. To relieve pain and spasm.
2. To lessen secretions.
3. To allay motor excitement, diminish muscular action, and prevent hemorrhage.
4. To abort inflammation.
5. To act as a stimulating and supporting agent.

The sudorific action of the drug upon the lower animals is slight and comparatively unimportant. Among the preceding indications the first three naturally follow from the physiological action of

opium, while the latter two are deduced solely from clinical experience.

1. Although the anodyne and sedative action of opium is not so marked in its influence upon veterinary patients as in human subjects, yet it is by far the most valuable agent we possess for relieving pain of any description, particularly when combined with atropine. In spasmodic colic of horses, opium arrests pain by preventing irregular and violent peristaltic action. It may be given as morphine (with atropine), subcutaneously; or as laudanum, with ether and chloroform in a drench, simultaneously with an aloes ball. In this affection opium actually assists the action of the purgative by overcoming spasm. Pain directly antagonizes the effect of opium, and repetition of the dose is both justifiable and necessary until relief is obtained. Hypodermic medication is therefore safer when the dose has to be repeated, in enabling the practitioner to decide that failure to relieve pain is due to insufficient dosage rather than to delayed absorption from the digestive canal.

Opium is indicated in all forms of pain and in motor excitement in cerebritis and meningitis. The pains and spasmodic contractions resulting from acute or traumatic meningitis are benefited by opium; also neuralgic and rheumatic pains. The spasms of eclampsia and tetanus are eased when opium is combined with chloral in enema, or when morphine is injected under the skin. The injection of morphine under the skin may prove antidotal in strychnine poisoning. Five grains saved a collie dog which had supposedly received a fatal dose of strychnine. Clonic spasm of the diaphragm in horses ("Thumps") is also treated successfully with opium. Morphine under the skin is useful in asthma in dogs.

The subcutaneous use of morphine sulphate (gr.ss-i) in dogs 30 minutes before operation is of the greatest service in causing easy ether anesthesia and permitting the use of the minimum amount of ether. After the animal has once been etherized the author has frequently done gastro-jejunostomy and even partial gastrectomy without any further ether being required.

2 and 3. Opium is invaluable in lessening secretion, motion and pain in various digestive disorders. Gastric digestion is inhibited by the action upon secretion and motion, and opium should not be administered immediately after the ingestion of food, unless the demand for it at that time is imperative. Laudanum or morphine are also valuable in preventing threatened abortion, and in the treatment of after-pains and post-partum hemorrhage in mares, cows and bitches.

Excessive vomiting in dogs may be combated with opium and bismuth, or with morphine hypodermatically. Opium quiets peris-

talsis and secures rest of the canal in gastritis and gastro-enteritis. In superpurgation and in all forms of diarrhea and dysentery, opium is the remedy par excellence. (Laudanum in dose of 5-10 drops for large birds is an efficient remedy for diarrhea in poultry.) Its administration in these disorders should be accompanied, or preceded, by an oleaginous (horse), saline (herbivora) or mercurial (horse and dog) purgative; and its action may be assisted by astringents, alkalies, mineral acids, and intestinal antiseptics in various combinations suited to the particular case. The following formulæ are useful in diarrhea of horses and cattle. Laudanum and spirit of camphor, each ℥ i, with tinc. capsicum, ʒ i. in drench thrice daily; or ʒ i. each of pulv. opium and catechu, with ℥ i. each of chalk, ginger and sodium bicarbonate in flour gruel twice daily. One third of this prescription is suitable for calves. For dogs 5 to 10 minims of laudanum may be added to a tablespoonful of mistura cretae; or to half a dram of bismuth suspended in water.

Peritonitis, enteritis, and acute obstruction of the bowels are treated most successfully with opium, which quiets the bowels, relieves pain and facilitates the vis medatrix naturæ, besides acting as an antiphlogistic in the first-mentioned diseases. By preventing muscular activity and allaying general excitability, opium is the most effective hemostatic in all internal hemorrhages, and it quiets the heart most effectively in acute endocarditis.

Cough, as a symptom of irritation within the respiratory tract, is more commonly treated by some form of opium than by any other drug. When cough is irritative or excessive, and is not remedial in removing secretion, then it is very properly controlled by opium. If, on the other hand, respiratory movements are weak, or cyanosis threatens from retained secretions, opium is distinctly contraindicated, since it depresses the respiratory centres and lessens the irritation produced by the secretions in the bronchial tubes, which would otherwise cause coughing and expulsion of the exudate. Morphine sulphate (gr. $\frac{1}{10}$ to gr. $\frac{1}{6}$) may be given in chloroform water every 3 hours in troublesome cough in house dogs.

Opium, especially when combined with belladonna, notably diminishes secretions, so that this combination is peculiarly appropriate in the treatment of cough and exudation, and it is only when increasing moist rales are found to exist during this medication that it should be stopped. Pleuritic cough causes intense pain and accomplishes nothing, so that opium here affords great relief without inducing bad results.

4. Opium possesses antiphlogistic action in aborting and combating inflammation. Reflex excitability is lessened by opium, and therefore irritation of nerve centres, which would otherwise cause

vascular dilatation, stasis, and inflammation, is prevented by the drug. This is at least the theory. Opium and quinine are the two remedies having the most popular clinical reputation for aborting colds and inflammation, and the latter agent also diminishes reflex excitability. Inflammation of serous membranes is thought to be that form most favorably influenced by opium, as peritonitis, enteritis and meningitis, for which purpose the drug is frequently combined with calomel. But opium is also an extremely useful antiphlogistic remedy in coryza, bronchitis, pneumonia and pleurisy, and in inflammations of the mucous coat of the digestive canal, as gastritis and dysentery. A single full dose should be given at the earliest possible stage of these disorders, and the patient should be kept as quiet as possible to secure the best result.

5. Opium stimulates and supports the system in a manner not explicable on physiological grounds. It often conserves life in a remarkable way in patients weakened by long continued disease and in those suffering from shock, loss of blood following surgical operation, parturition, or other natural causes. Opium in some form (often as codeine) is the most useful remedy in diabetes mellitus, in dogs, in reducing the loss of glucose in the urine.

Contra-indications.—In respiratory diseases associated with cyanosis or excessive exudation, in very high fever and obstinate constipation. The drug must be used with caution in the treatment of the aged and very young.

APOMORPHINE HYDROCHLORIDUM. Apomorphine Hydrochloride.
$C_{17}H_{17}N\,O_2H\,Cl$. (U. S. & B. P.)

Derivation.—The hydrochloride of an artificial alkaloid, obtained by heating morphine (or codeine) in hermetically closed tubes, with an excess of pure hydrochloric acid. The morphine thus loses one molecule of water; $C_{17}H_{19}N\,O_3 = C_{17}H_{17}N\,O_2 + H_2O$.

Properties.—Minute, grayish-white, shining, monoclinic prisms, without odor, having a faintly bitter taste, and acquiring a greenish tint upon exposure to light and air. Soluble in about 39.5 parts of water, and about 38.2 parts of alcohol; very little soluble in ether or chloroform. It should be kept in small, dark, amber-colored vials. (U. S. P.)

Dose.—Subcutaneously. H., gr. ¾ (0.045). Foals, gr. ½ (.03). Sh. & Calves, gr. ½ (.03). Cows, gr. 1½ (.09). D., gr. ⅒-⅕ (.006-.012). By the mouth, D., gr. 1/40-1/25 (.0015-.0024) as expectorant.

PREPARATION.

Injectio Apomorphinæ Hypodermica. (B. P.)

One per cent.

Dose.—H. m. 75. Sh. & Calves, m. xl. D. m. x.-xx.

Action Internal.—Small doses (gr. $\frac{1}{60}$-$\frac{1}{30}$) cause vomiting in dogs, while larger doses produce salivation and trembling in addition to vomition. Very large quantities (gr. 4-5) occasion first great excitement; the dog howls, runs and jumps about, the pupils are dilated and the slightest noise excites great alarm. Then the animal weakens in the hind legs, becomes paraplegic, falls and goes into convulsions. The breathing, at the beginning rapid, becomes weak and slow. Death ensues from respiratory failure.

Nervous System.—The drug primarily stimulates the brain and induces delirium and excitement, but secondarily causes cerebral paralysis. The origin of the convulsions is not ascertained. Apomorphine is a direct local paralyzant to the muscles. acting upon their substance or upon the motor nerve endings.

Circulation.—Medicinal doses do not alter the force, but may increase the rate and tension of the pulse by stimulation of the cardiac accelerator nerves and vasomotor centres. Toxic doses paralyze the heart muscle and lower blood pressure.

Respiration.—The respiratory movements are at first markedly increased by large doses of apomorphine. The reason for this is uncertain. Lethal doses depress and paralyze the respiratory centre. The breathing then becomes feeble and infrequent. The agent causes a copious outpouring of a watery fluid from the blood vessels of the respiratory mucous membrane, and is, therefore, an expectorant.

Vomiting Centre.—This is stimulated by therapeutic doses of apomorphine, but paralyzed by toxic doses, so that vomiting may not occur in poisoning. Apomorphine does not act locally upon the stomach.

Uses.—Apomorphine is a reliable, prompt and powerful emetic. The alkaloid is generally given under the skin and can be administered along with zinc sulphate or other emetic in poisoning. In narcotic poisoning, as with chloral or opium, apomorphine—like other emetics—may fail to act efficiently. In the first stage of acute bronchitis, apomorphine is useful in canine practice, and again in the later stage, when the animal becomes choked with exudation. The drug, in a mild emetic dose, will aid recovery by causing violent expiratory efforts during vomition, and these tend to expel se-

cretions, which is furthermore assisted by the action of the alkaloid in rendering the secretions less viscid. Chronic dry bronchitis of dogs is likewise benefited by apomorphine. In pica in cattle, 1½ gr. may be given on three consecutive days or in recent cases, gr. iii. are given subcutaneously in the same way.

In pica in foals, sheep and calves the drug is equally effective in smaller doses. Even in parrots and other birds gr. 1½ in water by the mouth may cure the habit of plucking out the plumage.

Apomorphine must be used with some caution in foals and horses since F. Smith has reported an alarming condition in the horse produced by the giving of two grains under the skin attended with delirium, great restlessness, constant movement of the limbs, excitement and sweating.

Apomorphine hydrochloride sometimes relieves choking in animals by its relaxing spasm and increasing secretion of the gullet. Three-quarters of a grain may be injected under the skin in horses. It should be tried before using a probang, as, if successful, it will act within fifteen or twenty minutes.

The alkaloid decomposes in crystal, and rapidly in solution, becoming toxic and of a green hue. Solutions should be freshly prepared.

Class 2.—Stimulating the Brain.

Belladonnæ Folia. Belladonna Leaves. (U. S. & B. P.)

Synonym.—Deadly nightshade, E.; folia S. herba belladonnæ, feuilles de belladonne, Fr.; tollkraut, tollkirschen blätter, wolfkirschen-blätter, G.

Derivation.—The dried leaves of *Atropa Belladonna* Linné (Fam. *Solanaceæ*), yielding, when assayed by the U. S. P. process, not less than 0.35 per cent. of mydriatic alkaloids.

Usually of a dull brownish-green color, the leaves much wrinkled and matted together, frequently with the flowering tops intermixed; leaves from 6 to 20 Cm. long, 4 to 12 Cm. broad, broadly ovate, apex acute, margin entire, narrowed into the petiole, upper surface brownish-green, lower surface grayish-green, epidermis more or less papillose, particularly on the under surface; odor distinctly narcotic, especially on moistening; taste somewhat bitter and acrid.

The powder is characterized by few hairs and numerous, small, arrow-shaped crystals of calcium oxalate.

Constituents.—Two alkaloids; 1, atropine, the chief one, representing the action of belladonna; and, 2, hyoscyamine.

Atropine is now considered to be an artificial product of hyoscyamine, and therefore the latter to be the natural alkaloid. Belladonna leaves should contain not less than 0.35 per cent. atropine.

Dose.—H. & C., ℥ ss.-i. (15.-30.); D., gr.i.-v. (.06-.3).

PREPARATIONS.

Extractum Belladonnæ Foliorum. Extract of Belladonna Leaves. (U. S. & B. P.)

Made by percolation with diluted alcohol, and evaporation to pilular consistence. Used in preparing the unguentum belladonnæ. Contains 1.4 per cent. of mydriatic alkaloids.

Dose.—H. & C., gr.x.-xx. (.6-1.3); Sh. & Sw., gr.ii.-iv. (.12-.24.); D., gr.$\frac{1}{8}$-$\frac{1}{2}$ (.008-.03).

Tinctura Belladonnæ Foliorum. Tincture of Belladonna Leaves. (U. S. & B. P.)

Belladonna leaves, 100, diluted alcohol to make 1,000. Made by maceration and percolation. (U. S. P.)

Dose.—D., ♏v.-xxx. (.3-2.).

Unguentum Belladonnæ. Belladonna Ointment. (U. S. & B. P.)

Extract of belladonna leaves, 10; diluted alcohol, 5; hydrous wool fat, 20; benzoinated lard, 65. (U. S. P.)

Belladonnæ Radix. Belladonna Root.

Synonym.—Racine de Belladonne, Fr.; wolfskirschenwurzel, tollkirschen-wurzel, G.

Derivation.—The dried root of *Atropa Belladonna* Linné (Fam. *Solanaceoe*), yielding, when assayed not less than 0.5 per cent. of mydriatic alkaloids.

In cylindrical or somewhat tapering, longitudinally wrinkled pieces, 1 to 2.5 Cm. thick, the bark somewhat incurved at the edges of roots which have been split before drying; externally pale brownish-gray, dusty or mealy, outer layers of the periderm rather soft, frequently abraded, and thus showing lighter patches; fracture nearly smooth, mealy, and emitting a characteristic puff of dust; internally whitish, the older roots showing medullary rays near the bark; nearly inodorous; taste sweetish, afterwards bitterish and strongly acrid.

Constituents.—Same as leaves. Contains not less than 0.5 per cent. atropine.

PREPARATIONS.

Fluidextractum Belladonnæ Radicis. Fluidextract of Belladonna Root. (U. S. P.)

Made by percolation with alcohol and water, and evaporation. One cc. of the extract = one gm. of belladonna root. Standarized so that 100 cc. of the fluidextract contain 0.5 gm. of mydriatic alkaloids. The most reliable preparation.

Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iii. (8.-12.); Sh. & Sw., ♏x.-xv. (.6-1.); D., ♏i.-iii. (.06-.2).

Linimentum Belladonnæ. Belladonna Liniment. (U. S. & B. P.)

Camphor, 50; fluidextract of belladonna to make 1,000. (U. S. P.)

Atropina. Atropine. $C_{17}H_{23}NO_3$. (U. S. & B. P.)

An alkaloid obtained from belladonna. As it occurs in commerce, it is always accompanied by a small proportion of hyoscyamine extracted along with it, from which it cannot readily be separated.

Derivation.—Atropine is obtained from a strong tincture of the root. Slaked lime is added, which splits up atropine malate and precipitates lime malate. The excess of lime is precipitated by sulphuric acid, and coloring matters by potassium carbonate, which also sets free atropine. The atropine is dissolved in chloroform, recovered on evaporation, and purified by digestion with warm alcohol and charcoal.

Properties.—White, acicular crystals, or a more or less amorphous white powder; without odor, having a bitter, acrid taste, and gradually assuming a yellowish tint on exposure to air. Soluble in 450 parts of water, 1.46 parts of alcohol, 16.6 parts of ether, 1.56 parts of chloroform, and about 50 parts of glycerin. At about 113.8° C. (237° F.) it melts, forming a colorless liquid. At about 140° C. (284° F.) it begins to give off white, acrid fumes, and when ignited, it is consumed without leaving a residue. It has a markedly alkaline reaction; its saturated aqueous solution acquires a pink color upon the addition of a drop of phenolphtalein.

Incompatibles.—Decomposed by sodium or potassium hydrate.

Dose.—H., gr.ss.-iss. (.03-.09); average dose, gr.i. (.06); C., gr.i.-ii. (.06-.12); Sh. & Sw., gr. $\frac{1}{20}$-$\frac{1}{12}$ (.003-.005); D., gr. $\frac{1}{120}$-$\frac{1}{60}$ (.0005-.001).

ATROPINÆ SULPHAS. Atropine Sulphate. $(C_{17}H_{23}NO_3)_2\ H_2SO_4$. (U. S. & B. P.)

Derivation.—Atropine is dissolved in sulphuric acid and treated with ether, when the insoluble sulphate settles out.

Properties.—A white crystalline powder or microscopical needles and prisms (the form of the latter being probably due to the hyoscyamine present); odorless, having a very bitter, nauseating taste, and permanent in the air. *It should be tasted with the utmost caution, and only in dilute solution.* Soluble in 0.38 part of water, 3.7 parts of alcohol, 2140 parts of ether, and in 620 parts of chloroform at 25° C. (77° F.). At about 189.9° C. (373.5° F.) Atropine Sulphate melts; when free from hyoscyamine it melts at about 118° C. (370.4° F.). When ignited it chars, emits acrid vapors, and is rapidly and completely consumed.

Dose.—H., gr.i.-iss. (.06-.09); C., gr.i.-ii. (.06-.12); Sh. & Sw., gr. $\frac{1}{15}$-$\frac{1}{12}$ (.004-.005); D., gr. $\frac{1}{120}$-$\frac{1}{80}$ (.0005-.0008), average dose, gr. $\frac{1}{100}$ (.0006).

ACTION OF BELLADONNA AND ATROPINE.

External.—Belladonna is ordinarily not absorbed from the unbroken skin, but when applied to raw surfaces and mucous membranes, or, to a less extent, when rubbed into the skin with camphor (linimentum belladonnæ), chloroform, alcohol, etc., it depresses the sensory nerve endings and produces a local anodyne action. Thus applied it also depresses the peripheral motor nerve fibres, and is sometimes injected into spasmodically contracted muscles for relief of spasm. The vessels are said to be first contracted and then dilated by the local action of the drug, and the secretions of the skin are diminished.

Internal.—Digestive Tract.—Belladonna (atropine) apparently diminishes the gastric secretion and is largely used to lessen gastric hyperacidity. In the intestines atropine prevents undue griping produced by drastic cathartics by some unknown action, since the inhibitory sphlanchnic endings are not depressed as has hitherto been taught. Large doses of atropine excite peristalsis through stimulation of Auerbach's plexus (Magnus).

Circulation.—Belladonna is readily absorbed into the blood, but has no particular action upon this fluid within the body. Dilute solutions of atropine paralyze and stop corpuscular movement in the blood withdrawn from the vessels. The characteristic action of belladonna upon the circulation consists in *depression of the peripheral pneumogastric fibres in the heart,* with greater frequency of the

pulsations. There is also, probably, a slight stimulation of the cardiac muscle. Belladonna is therefore a heart stimulant, by increasing the number of its beats without diminishing their force. Large doses sometimes give rise to primary slowing of the pulse, owing to stimulation of the inhibitory apparatus. Blood pressure is exalted synchronously with the increased frequency of the heart, and is due to cardiac stimulation and also to stimulation of the spinal and medullary vasomotor centres, with constriction of blood vessels of the abdomen.†

In poisoning, vascular tension is considerably lowered because of paralysis of the vasomotor centres, smooth muscles (or ganglia), of the vessel walls (with vascular dilation), and the heart muscle itself.

Nervous System.—Cerebrum.—Belladonna is classed as a delirifacient by some authorities,—notably Wood. It stimulates the brain incoördinately, and large doses produce restlessness, nervous excitement and delirium in man, and occasionally delirium in the lower animals. Stimulation is succeeded by exhaustion and some depression, with stupor rather than coma.

Spinal Cord.—Belladonna appears to exert a double action (stimulant and depressant) upon the spinal cord. The spinal vasomotor and respiratory centres are stimulated. Large doses cause complete loss of motion and reflex action in the frog, lasting for several days, and followed by reflex excitability and convulsions. Poisoning in mammals is exhibited by less paralyzant action accompanied by more convulsive movements. Various explanations have been offered to reconcile these phenomena. The prevalent theory is, that, following complete paralysis of the spinal cord, the motor and sensory tracts recover before the inhibitory centres, so that normal stimuli pass through the latter unrestrained and result in convulsions.

Nerves.—The action of belladonna upon the nerve endings is extremely important, and represents, to a considerable degree, the therapeutic value of the drug. The peripheral motor nerve terminations, and, to a less extent, their trunks, are depressed and paralyzed. This is never so complete, however, but that there is some voluntary power left in an animal fatally poisoned. Depression and loss of function of the afferent nerves come on more slowly, and exist to a less degree. Belladonna, then, when applied locally or given internally, is an anodyne, but is far inferior in this respect to opium: and, whereas opium acts centrally, belladonna acts periph-

† Dilatation of the vessels of the skin occurs at the same time but this is insufficient to reduce blood pressure. In man this is shown by flushing of the skin and a bright rash on the face and neck after large doses.

erally. The terminations of all secretory nerves are also depressed and paralyzed by belladonna, and secretions are therefore diminished.

Secretions.—Dryness of the mouth is one of the first physiological symptoms following the administration of belladonna. This is due to paralysis of the peripheral terminations of the secretory nerve (chorda tympani) of the submaxillary gland, and of the secretory nerve endings of the other salivary and mucous glands in connection with the mouth. Another characteristic effect of belladonna consists in the production of dryness of the skin, which follows the action of the drug in paralyzing the peripheral nervous filaments supplying the secretory cells of the sudoriparous glands. In the same manner the tracheal and bronchial secretions are diminished, and also the secretion of milk (anti-galactagogue action), by depression of the terminations of the secretory nerves. The drug does not exert any decided influence upon the secretions of the intestinal tract, but the secretion of gastric juice is diminished or arrested and, to a less degree, that of the pancreatic juice and bile. The HCl in the gastric juice is much more reduced than the pepsin or fluid as a whole. The amount of urine is sometimes increased after the ingestion of small doses of belladonna, but is considerably lessened, or suppressed, in poisoning by the drug. Experiments upon man show that the urinary solids are increased: urea and uric acid to a slight extent; sulphates and phosphates to a considerable degree.

Muscles and their Nerves.—Atropine is antispasmodic in its effect upon involuntary muscle. It depresses both the unstriped fibres and their motor nerve endings. Toxic doses cause paralysis of the smooth muscles. Voluntary muscles are not affected by any doses of atropine, although the motor nerves controlling them are depressed by toxic amounts of the alkaloid. Small doses of atropine, given experimentally to animals, do not appear to affect peristalsis at all and do not alter the normal influence of the vagus or splanchnic nerves. Its action in preventing griping and the violent peristaltic movements of pilocarpine can not be explained except by its effect on some unknown mechanism. After large doses, as has been noted above, intestinal action is stimulated and vomiting and purging occur in poisoning by the drug.

Atropine has been used successfully to produce three diverse actions on the bowel: (1) to quiet intestinal movement in inflammation of the bowels; (2) to relieve spasm in colic and spastic conditions generally; (3) very commonly to aid catharsis in sluggish states of the intestines. In practice, small doses will often move the bowels effectively, while, on the other hand, enormous doses (gr. $\frac{1}{12}$, instead of the usual dose of gr. $\frac{1}{100}$) have recently proved success-

ful in moving the bowels in obstinate constipation (in human patients) due to obstruction,* when all other means failed. Conversely, it is, and has been, the common practice to give atropine with morphine to prevent peristalsis in peritonitis and with apparently satisfactory results. The cathartic action of atropine in small doses is not explicable by its known physiologic effect, but its sedative influence is noted in experimental work in preventing griping of drugs. The predominant action of belladonna in paralyzing the peripheral vagi in the heart has been described.

The pneumogastric terminations are depressed in the heart by moderate doses, while the heart muscle is paralyzed by large quantities of belladonna.

A like depressing influence is believed to be exerted upon the efferent nerve endings of the unstriped muscles of the bladder, urethra, uterus and vagina, as well as upon the muscles of these organs. Belladonna acts medicinally as an antispasmodic in relation to the muscles.

Respiration.—Small doses of atropine do not affect the respiration. Large therapeutic doses make the respiratory movements quicker and deeper, by stimulation of the medullary and spinal respiratory centres. Fatal doses produce respiratory failure and asphyxia, owing to paralysis of the respiratory centre and the peripheral vagus filaments concerned with the respiratory movements. Belladonna also paralyzes the peripheral fibres of the pneumogastric nerve in the bronchial tubes and acts therapeutically as follows: 1. As a respiratory stimulant; the drug is generally inferior to strychnine in this respect. 2. As an antispasmodic, by depressing the efferent vagus endings in the bronchial tubes and relaxing spasm of the smooth muscle of their walls. 3. As a sedative, by depressing the afferent vagus fibres and diminishing the irritation produced by secretion, so that cough is allayed. 4. As an agent lessening secretion.

Temperature.—Moderate doses of belladonna cause a rise of temperature, while fatal doses lessen bodily heat. The first phenomenon is produced by stimulation of the spinal thermogenic centres, while the latter effect follows the vasomotor paralysis which occurs after lethal doses.

An elevation of 2 to 5.4° F. has been noted in dogs after full doses of atropine, while a greater fall of temperature has been observed in the same animal in fatal poisoning. Elevation of temperature is accompanied by increased heat loss, caused by radiation from the dilated cutaneous vessels.

* It is probable in these cases that the obstruction was due to spasm, and not mechanical.

Eye.—The action of belladonna upon the eye affords another illustration of the depressing action of the drug upon the nerve terminations. The myoneural junctions of the third (oculomotor) nerve in the circular muscle are paralyzed, which leaves the radiating fibres free to act and they therefore draw back the edges of the iris and dilate the pupil. The nerve terminations in the radiating fibres do not seem to be influenced by atropine. The mydriatic action is exhibited, whether the drug be given by the mouth or dropped directly into the eye. In the former case, the drug does not act through the nervous system, but locally upon the peripheral filaments of the third nerve through the medium of the blood. The muscular fibres of the iris are unaffected by belladonna. The terminations of the sympathetic and the trigeminus may be stimulated, which would also produce dilation of the pupil. These latter actions are not definitely determined, while it is known that the dominant effect consists in depression of the oculomotor nerve endings, as before stated. Paralysis of accommodation follows paralysis of the terminations of the third nerve in the ciliary muscle, and therefore vision is disturbed. Intraocular tension is increased by large and continuous dosage of belladonna, and an artificial glaucoma may be thus produced.

Elimination.—Belladonna is eliminated by the kidneys and bowels; traces have been found in the milk. It is, however, chiefly oxidized in the body.

Summary.—It will be observed that belladonna, generally speaking, first stimulates and then depresses the nerve centres, while it chiefly paralyzes the motor nerve terminations, including the inhibitory (vagus), the secretory (chorda tympani, etc.), and, to a less extent, the sensory nerves. Secondary depression of the cerebrum is not so profound as that of the great medullary centres, especially the respiratory centre, and there is sometimes a slight and brief stimulation of the motor nerves of the smooth muscles, viz., vagus, splanchnic, and possibly vasomotor nerves.

Full medicinal doses depress the peripheral filaments of the inhibitory and secretory nerves and the motor nerves of the unstriped muscles, as well as the muscles themselves, lessen the functional activity of the voluntary motor system, and, to a less degree, that of the afferent nerves. The pulse becomes quickened because of paralysis of the peripheral vagus endings and stimulation of the heart; the blood tension is augmented because of the increased cardiac action and stimulation of the vasomotor centres; and the respiration is accelerated because of excitation of the respiratory centres. The temperature is elevated owing to the circulatory exaltation and stimulation of the heat-producing centres. Slight delirium may be

present from the exciting action of the drug upon the cerebral motor centres.

The spinal cord is unaffected by therapeutic doses. Locally applied, belladonna is a direct paralyzant to nerves, muscles, vessels and cells.

PHYSIOLOGICAL RELATIONS OF BELLADONNA TO OTHER DRUGS.

A medicinal dose of atropine stimulates, while morphine depresses, the brain, respiratory functions, and intestinal peristalsis. This antagonism ceases when poisonous doses of the two drugs are combined, and therefore atropine should be given with caution in the treatment of opium narcosis, so as not to aggravate the already existing central nervous depression, particularly of the respiration. Morphine relieves pain, causes sweating, and contracts the pupil centrally. Atropine dilates the pupil, produces dryness of the skin, and depresses the functions of sensory nerves through its peripheral action. Atropine antagonizes physostigma in so far as the latter stimulates the peripheral oculomotor nerve fibres, the vagi, diminishes blood pressure, depresses the respiratory centres, and stimulates the unstriated muscle of the intestines, and the secretions of the stomach, bowels and bronchial tubes.

Atropine is antagonistic—in part—to pilocarpine, which stimulates secretory nerve terminations in the sweat and salivary glands, the peripheral oculomotor filaments, and the nerve endings in the involuntary muscle of the heart, stomach, intestines and uterus. Atropine counteracts the influence of aconite and muscarin (the poison of fungi) upon the heart, and the action of the latter principle in producing spasm of the pulmonary vessels.

Toxicology.—Toxic doses of belladonna cause in animals dryness of the mouth, increased frequency of the pulse and respiration, elevation of temperature, dilation of the pupil and partial blindness, restlessness, nervousness, delirium, twitching of the muscles (occasionally erythema), and frequent micturition. These symptoms are succeeded, in fatal poisoning, by fall of temperature, retention of urine, muscular weakness, staggering gait, partial anæsthesia, convulsions and paralysis (one preponderating over the other), weak, slow, irregular respiration, feeble, rapid pulse, paralysis of the sphincters, stupor and death. Death occurs mainly from asphyxia, but is due in part to cardiac failure. The physiological test consists in placing a drop of the urine (secreted by the poisoned animal) into the eye of a healthy animal, when mydriasis should follow if the case be one of belladonna poisoning. Three-quarters of a grain of atropine under the skin has proved fatal to dogs. Two grains of

atropine produce mild toxic symptoms in the horse. Small dogs are slightly poisoned by gr. 1/80 of atropine; medium sized dogs by gr. 1/60 given hypodermatically. Cattle are as susceptible as horses, although herbivora are not so easily influenced as carnivora. The pulse in dogs is greatly accelerated, sometimes as high as 400, while the pulse rate of the horse is not generally more than doubled. Rodents, as guinea pigs and rabbits, and pigeons, are particularly insusceptible to belladonna, in regard to its effect upon the pupil, circulation, etc.

The treatment of poisoning includes the use of the stomach tube, emetics, pilocarpine, chloroform or ether in the stage of excitement; and cardiac stimulants, as caffeine, and artificial respiration in the later depression. Also external heat and general faradism.

Post-Mortem Appearances.—These are not generally characteristic, except of asphyxia. The blood is dark and poorly coagulable. There is congestion of the lungs, general passive hyperemia, and sometimes ecchymoses in the brain, cord, and their membranes. Congestion of the retina is said, however, to be pathognomonic of belladonna poisoning.

Administration.—The fluidextract of belladonna root is the official preparation more commonly used for horses. The alcoholic extract of the leaves is given in pill or suppository to dogs, and in electuary to horses. Atropine sulphate is employed under the skin when a rapid effect is desired.

Uses External.—Local application of belladonna is more effective when combined with internal medication of the same drug. Belladonna is used for mammitis, applied by massage in the form of liniment, and given by the mouth. It relaxes spasm, contracts the blood vessels, and lessens inflammation and congestion; paralyzes the secretory nerves and so diminishes the amount of milk, vascular tension, pain and glandular activity. In fissure of the rectum, and in hemorrhoids, belladonna (with opium) in ointment or suppository, allays spasm and pain. Liniment of belladonna is useful in rheumatic or neuralgic pain, and rubbed upon the throat, in cases of pharyngitis and laryngitis, affords a serviceable application, when combined with the internal administration of the drug.

Uses in Connection With the Eye.—In examination of the fundus of the eye, the media, or lens, for cataract, the pupil may be dilated to advantage with a weak solution (gr. 1/20-℥ i.) of atropine sulphate. A drop will suffice, and no trace of its effect will remain after the second day. A strong solution (gr.iv.-℥ i.) is essential to completely paralyze the iris and ciliary muscle. In the normal animal, accommodation is paralyzed and vision disturbed for 8 or 12 days after the use of this solution. Atropine is particularly useful

in keratitis and iritis. In the former disease, photophobia and blepharospasm are diminished by the paralyzing action of atropine upon the trigeminus, and pain, congestion and inflammation are diminished by contraction of the peripheral blood vessels. In central perforating ulcer of the cornea, with protrusion of the iris, atropine, by dilating the pupil, draws the iris away and prevents its permanent adhesion (anterior synechia) to the cornea, while the perforation is becoming filled with lymph and the anterior chamber is being restored. Strong solutions of atropine instilled at frequent intervals, are useful in iritis by (1) paralyzing and securing rest of the iris and ciliary muscles; (2) in lessening local blood supply, congestion and inflammation, and in preventing adhesions of the posterior surfaces of the iris to the anterior capsule of the lens (posterior synechiæ), which both limits the normal variation in the pupillary diameter and interferes with the nutrition of the lens, and so predisposes to cataract. Atropine is contraindicated in glaucoma.

Uses Internal.—The general indications follow directly from our knowledge of the physiological action of the drug. They are as follows:—1. To stimulate the respiration and circulation. 2. To diminish secretion. 3. To relieve spasm and pain.

1. Acute diseases, as pneumonia, bronchitis, influenza, cerebrospinal meningitis, etc., are frequently treated at the outset with belladonna, with the intent of cutting short the inflammatory process by producing general vascular contraction. This applies more particularly to pharyngitis, laryngitis and coryza where there seems good evidence to prove that sometimes a full dose of belladonna at the outset of these disorders may actually abort them. Besides there are the beneficial effects of the drug in relieving cough, spasm and obstructed breathing noted below. In the second stage of acute diseases, as pneumonia, belladonna is a valuable agent in combination with strychnine, to stimulate respiration, prevent effusion and vasomotor and cardiac depression. Belladonna is of service also as a respiratory, cardiac and vasomotor stimulant in poisoning by various drugs, including opium, chloroform, ether, aconite, prussic acid, physostigma and pilocarpine. Experiments by Reichert (*Therapeutic Monthly,* May, 1901) and others show that atropine, while stimulating the respiratory centre exerts a powerful depressing action on the pulmonic motor fibres of the vagi, and that in opium poisoning atropine, instead of strengthening, actually lessens respiratory power. Strychnine and caffeine are undoubtedly much better antidotes in this condition. Belladonna is an antidote in poisoning by antimony. In surgical shock, with low temperature, owing to vasomotor paralysis and vascular dilatation, and in collapse from injury and disease atropine is a most potent remedy, combined with camphor subcu-

taneously. In pneumonia, especially, belladonna is of great value following the crisis.

2. Belladonna is employed therapeutically to diminish excessive sweating and salivation, mercurial or otherwise. It is recommended in serous, or watery diarrhea. Edema of the lungs is combated most successfully with atropine (combined with strychnine) subcutaneously. In the second stage of acute respiratory diseases, as bronchitis, influenza, canine distemper, and pneumonia, belladonna diminishes secretion, irritability and cough, and stimulates the heart and respiration. It may be associated with opium to increase the sedative effect. Atropine is the best remedy, apart from antacids, to counteract gastric hyperacidity.

3. Belladonna does not have much influence over spasm of the voluntary muscles, unless injected (atropine) into their substance. Rheumatic lameness, neuralgia, and cramps and spasm due to injury of nerves, may be treated in this manner. Belladonna liniment or a local injection of atropine are indicated in that condition of the tender skin and muscles seen in horses and dogs after severe exercise. Spasm of involuntary muscle is, however, more easily overcome, and this action is of exceeding therapeutic importance. Intestinal spasmodic colic of horses succumbs most readily when atropine is given with morphine under the skin. In peritonitis and enteritis, full and repeated doses of atropine, with morphine, assist in paralyzing the smooth muscular fibres of the intestines, and in quieting peristaltic movement. Large doses of atropine have been recently used in human medicine, and with remarkably good results, in the treatment of intestinal obstruction from impacted feces, and even in invagination and twist.

Cough, stridulus breathing, and spasm, associated with acute pharyngitis and laryngitis, are influenced favorably by belladonna, in the first stage. The drug acts locally to paralyze the ends of the motor nerves in the throat, relieves spasm, and also contracts the peripheral vessels and overcomes congestion and inflammation. It may be given to horses in electuary, and also applied in liniment or ointment externally. The following prescription is suitable for horses suffering from pharyngitis or laryngitis.

℞

Fluidextr. Belladonnæ Rad..... ʒ i.
Pulv. Potassii Chloratis..... ʒ ii.
Pulv. Glycyrrhizæ..... ʒ v.
Syrupi Fusci..... Q. S.

M. et f. electuarium.

Sig. Give ½ ounce every two hours. (Furnish ½ ounce for sample dose.)

In bronchitis and asthma, belladonna also allays spasm and lessens secretion, irritation and cough. Other spasmodic conditions benefited by belladonna are, "thumps," lead colic, convulsions (with bromides), spasm of the rectum owing to fissure or other causes, and incontinence of urine due to spasm of the neck of the bladder. Palpitation of the heart is relieved by the sedative action of the mydriatic upon the unstriated cardiac muscle. Tetanus is favorably influenced by extract of belladonna given in electuary. In this section may be included the effect of small doses of belladonna in acting as a laxative in constipation, and thus assisting the action of peristaltic stimulants, as aloes and strychnine. Pills containing aloin (gr. ¼), extractum belladonnæ alcoholicum foliorum (gr. ⅛), and extractum cascaræ sagradæ (gr. ½), form a useful laxative combination in chronic constipation of dogs.

Hyoscyamus. Hyoscyamus. (U. S. P.)

Synonym.—Hyoscyami folia, B. P.; henbane, herba hyoscyami, E.; feuilles de jusquiame noire, Fr.; bilsenkrant, G.

The dried leaves and flowering tops of *Hyoscyamus niger* Linné (Fam. *Solanaceæ*), collected from plants of the second year's growth, and yielding, when assayed, not less than 0.08 per cent. of mydriatic alkaloids.

Habitat.—Indigenous to England, the Continent, and Asia, and naturalized in the northern part of the United States.

Description.—Leaves ovate or ovate-oblong, the lower with a short petiole, the upper sessile, 5 to 25 Cm. long, 2 to 10 Cm. broad, acute, coarsely and angularly toothed or lobed, grayish-green, glandular-hairy, particularly on the lower surface; flowers nearly sessile, with an urn-shaped, unequally 5-toothed calyx and a campanulate, purple-veined corolla, which in the fresh state is yellowish; fruit capsular, 2-celled, and enclosed in the calyx; odor, heavy, narcotic: taste somewhat bitter and nauseous. The powder is grayish-green and contains calcium oxalate in single or twin monoclinic prisms about 0.010 Mm. in diameter.

Constituents.—Two alkaloids: hyoscyamine $C_{17}H_{23}NO_3$, and hyoscine. The first resembles atropine is composition and action. Impure, amorphous, commercial hyoscyamine is a dark-brown fluid and contains as its active principle mainly hyoscine.

Incompatibility.—Incompatible with caustic alkalies and vegetable acids, lead acetate and silver nitrate. Hyoscyamus may be given in pill with the two latter mineral salts.

Dose.—H. & C., ʒ ss.-i. (15.-30.); D., gr.v.-xv. (.3-1.).

PREPARATIONS.

Extractum Hyoscyami. Extract of Hyoscyamus. (U. S. & B. P.)

Made by evaporation of the fluidextract to pilular consistency. The extract should contain 0.3 per cent. of mydriatic alkaloids.

Dose.—H. & C., gr.xx.-3 i. (1.3-4.); D., gr.ss.-ii. (.03-.12).

Fluidextractum Hyoscyami. Fluidextract of Hyoscyamus. (U. S. P.)

Made by maceration, percolation with alcohol and water, and evaporation, so that 1 cc. = 1 gm. of hyoscyamus. Each 100 cc. of fluidextract contains 0.075 gm. of alkaloids from hyoscyamus.

Dose.—H. & C., ʒ ss.-i. (15.-30.); D., ♏ v.-xv. (.3-1.).

Tinctura Hyoscyami. Tincture of Hyoscyamus. (U. S. & B. P.)

Hyoscyamus, 100; diluted alcohol to make 1000. Made by maceration and percolation. Standardized to contain 0.007 gm. of mydriatic alkaloids in each 100 cc. of the tincture. (U. S. P.)

Dose.—D., 3 i.-iv. (4.-15.).

The dose of hyoscyamus preparations is generally two to four times that of similar belladonna preparations.

Succus Hyoscyami. Juice of Hyoscyamus. (B. P.)

Dose.—Same as tincture.

Hyoscyaminæ Sulphas. Hyoscyamine Sulphate.

$(C_{17}H_{23}NO_3)_2 H_2SO_4$.

The neutral sulphate of an alkaloid obtained from Hyoscyamus and other plants of the *Solanaceæ*. It should be kept in amber-colored, well-stoppered vials.

Derivation.—Hyoscyamine is derived from hyoscyamus seed. The latter are treated with ether to extract fat, and then distilled with alcohol and sulphuric acid. The liquid residue is neutralized with caustic soda and precipitated with tannic acid. The precipitate is mixed with lime and extracted with alcohol. The resulting alcoholic solution is first treated with sulphuric acid, then with caustic soda, and finally with ether, which dissolves the alkaloid. The latter is recovered by distillation.

Properties.—White, indistinct crystals, or a white powder; odorless, having a bitter, acrid taste; deliquescent when exposed to the air. Very soluble in water, and in 6.4 parts of alcohol; very slightly soluble in ether or chloroform.

Dose.—H., gr.i.-ii. (.06-.12); D., gr. 1/60-1/30 (.001-.002).

Hyoscyaminæ Hydrobromidum.

Hyoscyamine Hydrobromide. $C_{17}H_{23}N\,O_3H\,Br$. (U. S. P.)

The hydrobromide of an alkaloid obtained from Hyoscyamus and other plants of the *Solanaceæ*. It should be kept in amber-colored, well-stoppered vials.

Properties.—White, prismatic crystals, or a yellowish, amorphous, resin-like mass, having, particularly when damp, a tobacco-like odor, and an acrid, nauseous, and bitter taste; deliquescent on exposure to the air. Very soluble in water; soluble in 2 parts of alcohol, 1600 parts of ether, and in 2.5 parts of chloroform at 25° C. (77° F.).

Dose.—H., gr.i.-ii. (.06-.12); D., gr. $\frac{1}{60}$-$\frac{1}{30}$ (.001-.002).

Hyoscinæ Hydrobromidum. Hyoscine Hydrobromide.

$C_{17}H_{21}N\,O_4H\,Br$. (U. S. P. & B. P.)

The hydrobromide of an alkaloid obtained from hyoscyamus.

Properties.—Colorless, transparent, rhombic crystals; odorless and having an acrid, slightly bitter taste. Permanent in the air. Soluble in 1.5 parts of water, and in 16 parts of alcohol; very slightly soluble in ether or chloroform.

Dose.—H., gr. $\frac{1}{6}$-$\frac{1}{4}$ (.001-.015); D., gr. $\frac{1}{100}$-$\frac{1}{30}$ (.0006-.002).

Action Internal.—The action of hyoscyamus is a resultant of that of its two alkaloids, hyoscine and hyoscyamine. The latter is practically atropine, except that its mydriatic action is shorter. Hyoscine, in poisonous doses, is a powerful depressant to the cerebrum, respiratory centre, spinal reflex centres, and motor tract. It differs from atropine in being a cerebral sedative, and in its greater paralyzant action upon the spinal cord. The tetanic stage succeeding spinal paralysis, observed in atropine poisoning, does not ensue with hyoscine. The latter alkaloid slightly depresses and slows the heart, and does not paralyze the vagus terminations, nor depress the motor and sensory nerves or muscles. The circulation is but slightly influenced, and vasomotor depression only occurs in the latter stage of lethal poisoning. Death occurs from paralysis of the respiratory centres. Poisoning in animals is exhibited by loss of muscular power, slowing and failure of respiration, dryness of the mouth, stupor and asphyxia. The pulse may be infrequent, the pupils are dilated and the skin is moist rather than dry. Delirium and convulsions sometimes occur in man. The effect of the combined action of hyoscyamine and hyoscine in hyoscyamus is shown when we compare the drug with belladonna. Hyoscyamus is more of a cerebral

sedative and hypnotic, and less of a heart and respiratory stimulant. It is said to possess more power in overcoming spasm, and griping of cathartics, and in aiding intestinal movement. Hyoscyamus is also thought to exert a more pronounced antispasmodic action than belladonna upon the smooth muscles of the bladder and urethra.

Uses.—Hyoscyamus is generally applicable in the same disorders for which belladonna is indicated. In relieving some sorts of spasm, hyoscyamus is more efficient than belladonna, as in spasmodic colic, spasm of the bladder, and griping caused by cathartics. Tetanus, chorea, and epileptic convulsions in dogs, are benefited by henbane, but the drug does not possess a curative action. Hyoscyamine may be combined to advantage with strychnine, subcutaneously, in impaction of the bowels in horses. The former drug relaxes intestinal spasms, and assists the stimulant action of strychnine upon the intestinal muscle. Repeated small doses of oil will facilitate peristalsis in this condition. Hyoscine hydrobromide is indicated in spasmodic affections and in nervous and sexual excitement. It is a powerful drug and should be employed at the outset in small doses. To avoid contamination with hyoscamine is difficult, and the preparation of Merck is to be recommended. Hyoscine has not been employed to any extent in veterinary practice. It is used in human medicine as a hypnotic and sedative in mania and delirium of the insane. It causes no unpleasant after-effects. Scopolamine is identical with hyoscine and is so named because obtained from *Scopola atropoides.* Scopolamine, or hyoscine, with morphine under the skin (after Korff) have been employed to some extent as general anæsthetics in human surgery to replace ether or chloroform. To aid in obstetric operations in cows, as in replacing an inverted uterus, scopolamine hydrobromide (gr. $\frac{1}{6}$) with morphine sulphate (gr.i.) may be injected subcutaneously, and the dose repeated in twenty minutes. Hyoscine (or scopolamine) is sometimes given to horses to aid the action of chloroform and prevent its excitement. One hour before operation gr. $\frac{1}{6}$-$\frac{1}{3}$ may be injected under the skin for this purpose. To produce general anæsthesia in dogs, morphine is given with hyoscine in 2 doses—one 2 hours, and the other 15 minutes, before operation. Thus (for each dose) morphine, gr. ss., with hyoscine, gr. $\frac{1}{100}$, are injected subcutaneously and will generally suffice for the performance of ordinary operations—although a few whiffs of ether may be required in addition. Dogs are comparatively insusceptible to scopolamine. It has been estimated by Bernardini that morphine may be given to the extent of gr. $\frac{1}{6}$ to each 2.2 lbs. of live weight; and hyoscine from gr. $\frac{1}{120}$ to gr. $\frac{1}{15}$ to each 2.2 lbs. live weight for dogs.

Cannabis Indica. Indian Cannabis. (U. S. & B. P.)

The dried flowering tops of the pistillate plants of *Cannabis sativa* Linné (Fam. *Moraceæ*), grown in the East Indies and gathered while the fruits are yet undeveloped, and carrying the whole of their natural resin.

Synonym.—Indian hemp, E.; chanvre indien, Fr.; indischer hanf, G.; herba cannabis indicæ, P. G.

Haschisch is a confection of the drug. Arabian habitués of this preparation are frequently impelled by its influence to deeds of violence. They are called "haschaschins"; hence the English, assassins. Gunjab, or ganga, is the dried plant used in India for smoking. Churrus is the resin and epidermis scraped off the leaves. Bhang consists of the young leaves, flowering and fruiting tops and resin resulting from the first season's growth.

Habitat.—The official cannabis is indigenous to Asia, but the common hemp plant (Cannabis sativa) grows in America and many other parts of the world.

Description.—In dark green or more or less brownish compressed masses, consisting of the densely paniculate branchlets, about 5 Cm. or more in length, and the inflorescence more or less agglutinated with a resinous exudation; commonly with a few undeveloped digitate leaves of one or more linear-lanceolate leaflets; clothed with numerous sheathing, pointed bracts, each containing two small mature but unfertilized pistillate flowers; odor agreeably narcotic; taste characteristic. In the powder few or no pollen grains or stone-cells should be present.

Incompatibility.—Water precipitates the active resinous principles. Lemon juice and other vegetable acids are the most efficient antidotes.

Constituents.—The active principle of cannabis indica is Cannabinol (O H C_{20} H_{28}C O H), a red oil or resin boiling at a high temperature, which apparently exerts the characteristic action (Marshall) of cannabis indica on man and animals. But the therapeutic value of the principle has not been sufficiently studied to enable it to be used as a substitute for the crude drug or its preparations. The drug yields various other bodies such as: 2. Cannabene, $C_{18}H_{20}$, or oil of Indian hemp, which is very toxic. 3. Cannabin, a resinoid. 4. Cannabindon, $C_8H_{12}O$, a dark, red syrup. 5. Cannabine, an alkaloid. 6. Cannabinone, a resin. The last three are given medicinally but have no advantage over the crude drug. 7. Cannabitetanine, a convulsant alkaloid.

PREPARATIONS.

Extractum Cannabis Indicæ. Extract of Indian Cannabis. (U. S. & B. P.)

Made by maceration and percolation with alcohol, and by evaporation to a pilular consistence.

Dose.—H., 3 i.-ii. (4.-8.); D., gr.¼-i. (.015-.06).

Fluidextractum Cannabis Indicæ. Fluidextract of Indian Cannabis. (U. S. P.)

Made by maceration and percolation. The alcohol is distilled off from the last part of the percolate, and the residue is dissolved in the first part (700 Cc.), and enough alcohol is added to make 1 Cc. of the fluid extract equal 1 gm. of the crude drug.

Dose.—H., 3 iv.-vi. (16.-24.); D., ♏ii.-x. (.12-.6).

Administration.—The extract is given in ball, pill, electuary or suppository; or the fluid preparations may be used.

Tinctura Cannabis Indicæ. Tincture of Indian Cannabis. (U. S. & B. P.)

Indian cannabis, 100; alcohol to make 1,000 Cc. Made by maceration and percolation. (U. S. P.)

Dose.—D., ♏xx.-xxx. (1.3-2.).

Action External.—Cannabis indica exerts a considerable irritant action when applied to mucous membranes. This is followed by local anæsthesia.

Action Internal.—Indian hemp is a distinct depressant to the functions of the brain and cord in poisonous doses, although therapeutically stimulating these organs in small quantities, and producing in man a kind of intoxication and mild delirium. The reflex activity of the spinal cord is primarily increased, but this is succeeded by diminution of reflex movement, and, after large doses, by anesthesia and loss of voluntary motion. The sensory tract (centres and nerves) is depressed by considerable therapeutic doses. Polyuria is seen after the ingestion of cannabis indica in dogs. The pulse is sometimes slowed by the drug through stimulation of the vagus and depression of the heart muscle and death is said to occur from the latter cause.

Death is extremely rare after the largest doses, however. Our knowledge of the detailed physiological action of the drug is imperfect. The action of cannabis comes on slowly and continues for a long time. A horse receiving, under the direction of the writer, at the Harvard Veterinary Hospital, ½ ounce of the solid extract, became drowsy. Sleep after a few hours deepened into stupor, and stupor

into coma. The respiration became slow, the pulse slightly accelerated, and the animal so anesthetic that amputation of the penis was done on the following day without producing the slightest pain or struggling. The animal had to be supported in slings, and only recovered after three days. Frequently neither constipation, anorexia, or other deleterious after-effects follow the action of this drug.

The following are extracts from experiments of Muir* with cannabis indica:

Gelding, 8 years old; condition poor. Gave two doses of fluidextract (Park Davis & Co. normal fluid) undiluted of 12.5 cc. each (about 3 drachms) intrajugularly, twenty minutes apart. Became rapidly nervous and excitable, increased by sounds or touch. In half an hour from first dose he became sleepy and stupid. A third dose of 15 cc. (½ ounce) was injected into the jugular about an hour after the first and caused sweating and a sleepy condition, in which the animal jerked and twitched his head as if dreaming. The temperature dropped to 96° F., and the sleepy state, alternating with excitement when annoyed lasted three hours, when delirium supervened and continued for six hours, at which time all the symptoms disappeared.

Pony. 575 pounds; condition fair. Received 15 cc. (½ ounce) of the fluidextract intravenously. In two minutes became delirious: in ten minutes was asleep against stall. In half an hour fell to floor and slept there for eighteen hours and could not be aroused. Temperature fell to 92.5° F. Respiration regular; pulse from 42 to 30 during experiment.

Gelding, 1050 pounds; in good condition. Given 45 cc. of fluidextract intravenously. In three minutes rearing, kicking, snorting and going on like one mad. He ran back and forth along one side of his stall like a caged tiger with sweat rolling off him and cutting and bruising himself, being apparently anesthetic. He endeavored to bite or strike anyone approaching and remained delirious and excitable for twelve to twenty-four hours.

Gelding, 650 pounds, 30 cc. of fluidextract injected into jugular. In four minutes became unsteady; in twelve minutes he was asleep; in half an hour he fell and so slept for eighteen hours. Temperature dropped to 91.° F. from normal; the pulse was accelerated and the respiration slightly so.

Muir deduces from his experiments that as much as 50 cc. (℥ iss.) of the fluidextract may be given with safety intravenously.

In the human being, cannabis induces very peculiar mental phenomena, including hallucinations, a sense of double consciousness, and great prolongation of time, so that minutes are drawn out into hours, and hours into days. Sometimes sexual excitement, exaltation, and hilariousness are exhibited; at other times a dreadful premonition of impending death seizes the human subject. The drug is not fatal, except in colossal doses, but the effects may appear

* Jour. Comp. Med. and Vet. Archives, April and May, 1900.

alarming. Intrajugular injection into a small dog, of five drachms of the fluidextract (10 minims of which proved active in man) only caused death after several hours (Hare). Preparations of Indian hemp vary greatly in strength, many being entirely inert, and this fact constitutes one of the principal objections to its use. The practitioner is recommended to experiment until he secures a reliable preparation, and use no other thereafter.

Uses.—Cannabis is indicated for the relief of: 1, pain; 2, spasm; 3, nervous irritability. It is not comparable to morphine as an analgesic, on account of the uncertainty and slowness of its action. It is only superior to opium in not causing constipation, anorexia and indigestion. It has been used therefore in single doses of an ounce of the extract in enteritis and colic and in laminitis, and often combined with chloral. The permanency of the action of Indian hemp suggests its use in conditions of long continued pain or spasm. In thirty-five cases of tetanus in the human being, treated with cannabis, twenty-one recovered and fourteen died. The results reported in veterinary practice have been almost as favorable; over half the cases have recovered when subjected to this medication. No drug, however, approaches phenol in its success in the cure of tetanus. Cannabis Indica is occasionally employed as a sedative for irritable cough, and to relieve the spasms of chorea and quiet the delirium of parturient apoplexy. It is also very serviceable in bladder irritation and cystitis in overcoming spasm.

The intrajugular injection of 10 to 15 cc. of a filtered reliable fluidextract of cannabis indica (Park, Davis) in horses will produce a rapid and safe general anesthesia for surgical operations. The animal will often lie down and is both relaxed and unconscious for a considerable period. Palmer affirms, however, that intravenous injections of cannabis sometimes cause thrombus and lameness in horses months afterwards owing to its insolubility in the blood (Vet. Review, Dec., 1913).

Caffeina. Caffeine. $C_8H_{10}N_4O_2 + H_2O$.
(U. S. & B. P.)

Synonym.—Theine, guaranine, E.; coffein, G.; caféine, Fr.

A feebly basic, proximate principle, obtained from the dried leaves of Thea sinensis Linné (nat. ord. ternstrœmiaceæ), or from the dried seeds of Coffea arabica Linné (nat. ord. rubiaceæ), and found also in other plants.

Habitat.—Indigenous to Africa, and cultivated in other tropical countries.

Derivation.—Crushed coffee is treated with successive portions of boiled water, and the resulting solution is precipitated with lead

acetate and filtered. Hydrogen sulphide decomposes the excess of lead acetate remaining in the filtrate. The latter is then concentrated by evaporation and neutralized with ammonia water. Caffeine crystallizes on cooling. The alkaloid is purified by charcoal and recrystallization.

Properties.—White, flexible, silky, glistening needles, usually matted together in fleecy masses, permanent in the air; odorless, and having a bitter taste. If crystallized from water, it contains one molecule of water of crystallization, but if crystallized from alcohol, chloroform, or ether, it contains none. Soluble in 45.6 parts of water, 53.2 parts of alcohol, 375 parts of ether, and 8 parts of chloroform at 25° C. (77° F.); soluble in 5.2 parts of water at 80° C. (176° F.), and in 17.1 parts of alcohol at 60° C. (140° F.). Its solubility in water is increased by the presence of certain salts,—*e.g.*, potassium bromide, sodium benzoate, sodium salicylate, and others. Caffeine is neutral to litmus paper.. Caffeine exists, curiously enough, as the active principle of the national non-alcoholic beverages in use all over the world. Coffee contains .6 to 2.2 per cent. of caffeine, together with glucose, fat, vegetable casein, tannic acid, and an empyreumatic oil developed by roasting, *i.e.*, caffeone. Tea contains 1.36 to 3. per cent. of caffeine, or theine, and also a volatile oil and tannic acid. Guarana (the seeds of Paullinia cupana) contains 4 to 5 per cent. of caffeine; maté, or Paraguay tea (the leaves of Ilex paraguayensis), contains .45 to 1.2 per cent. Caffeine is found in kola nut (the fruit of Sterculia acuminata), used as a beverage in Africa, and now as a nervous stimulant in human medicine, and is allied to theobromine, occurring in chocolate beans, and to cocaine, existing in coca leaves.

Incompatibility.—Caffeine is incompatible with mercury salts, potassium iodide and tannic acid.

Dose.—H. and C., 3 ss.-ii. (2.-S.); D., gr.-ss.-iii. (.03-.2), according to size. H., gr. xxx. subcut.

Caffeina Citrata. Citrated Caffeine. (U. S. P.)

Derivation.—Dissolve citric acid (50) in hot, distilled water (100); add caffeine (50) and evaporate the resulting solution, on a water bath, to dryness, constantly stirring towards the end of the operation. Reduce the product to a fine powder and transfer it to well-closed bottles.

Properties.—A white powder, odorless, having a slightly bitter, acid taste and an acid reaction. One part of Citrated Caffeine forms a clear, syrupy solution, with about 4 parts of hot water. Upon

dilution with 5 parts of water, a white, crystalline precipitate (caffeine) separates, which redissolves when about 25 parts of water have been added. It is also soluble in a mixture of equal volumes of chloroform and alcohol.

Dose.—H. & C., 5 ii.-iv. (8.-15.); D., gr. i.-vi. (.06-.36).

Action Internal.—Caffeine has no particular action upon the digestive tract, except in large quantities, when it may cause gastro-intestinal irritation. The effect of caffeine and raw coffee is identical, but when the latter is roasted, aromatic oils, or an empyreumatic oil, are developed (caffeone). It is impossible to separate completely the action of caffeine from caffeone in boiled coffee. Recent investigations appear to show that the oil (caffeone), of which there is from one to one-half drachm in a cup of the beverage, has no physiological action except to disturb digestion and cause biliousness. This result is not in accord with the general belief, and it is probable that caffeone possesses a transient action in stimulating intestinal peristalsis, the cerebral functions, and in lessening vascular tension.

Circulation.—Caffeine stimulates the heart muscle and vasomotor centres. The action of the heart is strengthened and accelerated after moderate doses in most cases. Sometimes the stimulating action on the vagus centre overcomes that on the heart and the pulse is somewhat slowed. Blood tension is enhanced. In poisoning the pulse becomes weak and irregular and the heart stops in diastole.

Nervous System.—Caffeine is a certain and direct stimulant to the higher nervous centres. In moderate doses it produces wakefulness and restlessness (action of tea and coffee at night on man), and increases the capacity for mental and physical work (see muscles). In the lower animals caffeine often causes the most intense cerebral excitement and mania in large doses. The alkaloid affects the spinal cord like strychnine, and toxic quantities produce restlessness, increased reflex excitability and convulsions in the lower animals. It is undetermined whether the convulsions are of cerebral or spinal origin. The motor and sensory nerves are unaffected by medicinal doses. Caffeine opposes the depressant action of opium and alcohol. It antagonizes alcohol in stimulating the highest or controlling functions of the brain, the reasoning faculties, perception of sensory impressions and association of ideas, and greater accuracy of touch and capacity for physical exertion.

Muscles.—The injection of caffeine solution into a frog's leg causes a stiffness and hardness of the muscles like that seen in rigor mortis. On muscle fibres, removed from the body, it acts in the same way by coagulating the muscle proteids. In small quantities in the body it stimulates the muscle to contract and increases

its capacity and endurance for work. The action of tea and coffee, in enabling men to perform more physical work, has hitherto been ascribed to the action of caffeine on the nervous system, but is now attributed to its effect on the muscles themselves.

Kidneys.—The kidneys primarily contract for two or three minutes with corresponding diminution in the flow of urine, after the subcutaneous injection of small doses of caffeine. This effect is independent of the general vascular condition, and is followed by an increase in the volume of the kidneys, with accompanying augmentation of the urinary secretion, as shown by experiments with Roy's oncometer. The renal cells are directly stimulated, and it is thought that caffeine also increases the blood supply of the malpighian bodies. The drug is therefore a local diuretic and (with theobromine) is the most efficient and powerful. No other drug can produce such a flow of urine.

Respiration.—The respiratory centres are stimulated (along with the vagus and vasomotor) by caffeine in moderate doses, and depressed by toxic amounts.

Metabolism.—Caffeine increases tissue change and therefore the elimination of urea and carbonic dioxide—contrary to the time honored teaching.

Toxicology.—Caffeine is a spinal and muscle poison to the frog. Tetanic convulsions occur in the batrachian similar to those produced by strychnine, but there is also muscular rigidity. These phenomena follow the direct stimulation of the spinal motor tract and muscles, and are succeeded by paresis. In man, stimulation of the cerebral cortex occurs, while both stimulation of the brain and cord are observed in the domestic animals. The symptoms of poisoning in dogs, cats and mammals generally, are restlessness, occasionally vomiting in dogs, rapid breathing, primary reduction followed by rise in temperature, clonic or tonic convulsions, muscular weakness, and general paresis. Death occurs from respiratory failure. The minimum fatal dose is about 1 gr. to 1 lb. of live weight in the cat.

Administration.—Caffeine and its ordinary salts are decomposed by water and therefore should not be given subcutaneously. The alkaloid is best administered in solution with sodium salicylate, or benzoate, for use under the skin as follows:—

℞

Caffeinæ .....
Sodii salicylatis .....āā gr.xxx.
Aquæ ..... ʒ ii.
M.
S. Give at one dose hypodermically to horse.
Ten drops to dog.

℞

Caffeinæ .....
Sodii benzoinatis .....āā gr.xxx.
Aquæ ..... 3 ii.
M.
S. Give at one dose under the skin, to horse.

The soluble citrate may be given internally, but it is not a definite or reliable preparation, and inferior to caffeine, which may be administered in solution with a little citric acid, or as above.

Uses.—Three indications for the use of caffeine may be deduced from our knowledge of its physiological action. 1. To stimulate the brain. 2. To stimulate the heart. 3. To cause diuresis.

1. Its application as a cerebral stimulant is very limited in veterinary medicine. It acts thus as an antidote to opium poisoning. One and a half grains of caffeine will save cats poisoned by the minimum fatal dose (gr. 1⅞) of morphine.

2. Caffeine possesses particular value in the treatment of dropsy of cardiac origin in dogs, because of its diuretic action, as well as stimulant effect upon the heart. The therapeutic indications are much the same as for digitalis, but caffeine differs from digitalis in the following particulars:

Does not slow the heart.	Is not cumulative.
Nor regulate the heart.	More transient in its effect.

Caffeine, in combination with acetanilid and other modern coal tar products, is useful in preventing their depressing action upon the heart. Furthermore, caffeine, tea and coffee are serviceable in the treatment of acute asthenic diseases in the horse (influenza), dog (distemper), and in foals and calves, acting as nervous and cardiac stimulants and perhaps restraining tissue waste. Caffeine is valuable in emergencies demanding immediate stimulation of the heart, respiration and vaso-motor centres as in belladonna, opium and cocaine poisoning.

3. The diuretic property of caffein renders it appropriate in aiding the absorption of pleuritic effusion, ascites, and dropsies, particularly of cardiac and renal origin, and in the hepatic form as well.

SECTION II.—DRUGS ACTING ON THE SPINAL CORD.

Class 1.—Stimulating the Inferior Cornua.

NUX VOMICA. Nux Vomica. (U. S. & B. P.)

Synonym.—Semen nucis vomicæ, poison nut, Quaker button, E.; noix vomique, Fr.; krähen-augen, brechnuss, G.

The dried, ripe seed of *Strychnos Nux-vomica* Linné (Fam. *Loganiaceae*), yielding, when assayed, not less than 1.25 per cent. of strychnine.

Description.—Orbicular, nearly flat, sometimes irregularly bent, 15 to 30 Mm. in diameter, 3 to 5 Mm. thick; externally grayish or greenish-gray, the surface covered with short, closely appressed, satiny hairs; rounded or somewhat acute at the margin, with a slight ridge extending from the centre of one side to the edge; internally whitish-gray, horny, very tough, the endosperm in two more or less regular concavo-convex halves, between which, at one end, lie the heart-shaped, palmately nerved cotyledons; inodorous; taste intensely and persistently bitter.

Constituents.—Two alkaloids. 1. Strychnine, 0.2-0.6 per cent. 2. Brucine ($C_{23}H_{26}N_2O_4$), 0.5-1.0 per cent. Similar in action to strychnine, but weaker and slower. Both alkaloids exist in combination with igasuric acid. Brucine occurs in rectangular octohedral crystals; is soluble in alcohol, in 7 parts of chloroform, and possesses a bitter taste. With sulphuric and nitric acids a beautiful blood-red color is developed. There are also, 4. Igasuric acid with which strychnine and brucine are combined. 5. Loganin, $C_{25}H_{34}O_{14}$, an inert glucoside occurring in colorless prisms.

Dose.—H. & C., 3 i.-ii. (4.-8.); Sh., gr.xx.-xl. (1.3-2.6); Sw., gr.x.-xx. (.6-1.3); D., gr.i.-ii. (.06-.12).

PREPARATIONS.

Extractum Nucis Vomicæ. Extract of Nux Vomica. (U. S. & B. P.)

Made by maceration with alcohol, water and acetic acid; percolation with alcohol and water, and evaporation. Standardized to contain 5 per cent. of (.06-.12); D., gr.$\frac{1}{8}$-$\frac{1}{4}$ (.008-.016).

Dose.—H. & C., gr.vii.-xv. (.5-1.); Sh., gr.ii.ss.-v. (.15-.3); Sw., gr.i.-ii. strychnine. (U. S. P.)

Fluidextractum Nucis Vomicæ. Fluidextract of Nux Vomica. (U. S. P.)

Made by digestion and percolation with alcohol, water and acetic acid. The alcohol is distilled off and the solution evaporated. Alcohol and water are added so that the fluidextract shall contain 1 per cent. of strychnine.

Dose.—H. & C., 3 i.-ii. (4.-8.); Sh., ♏xx.-xxx. (1.3-2.); Sw., ♏x.-xx. (.6-1.3); D., ♏i.-ii. (.06-.12).

Tinctura Nucis Vomicæ. Tincture of Nux Vomica. (U. S. & B. P.)

Made by solution of the extract of nux vomica, 20, in alcohol, and water to make 1,000. (U. S. P.) Contains 0.1 per cent. strychnine.

Dose.—D., ♏v.-x. (.3-.6).

STRYCHNINA. Strychnine. $C_{21}\ H_{22}\ N_2\ O_2$. (U. S. & B. P.)

An alkaloid obtained from nux vomica, and also obtainable from other plants of the natural order Loganiaceæ.

Derivation.—Nux vomica seeds are powdered and strychnine is extracted with water acidulated with hydrochloric acid. The solution is concentrated and strychnine precipitated with lime. It is then redissolved in boiling alcohol and the crystals are deposited upon concentration of the solution.

Properties.—Colorless, transparent, prismatic crystals, or a white crystalline powder; odorless, and having an intensely bitter taste, perceptible even in solutions of 1 in 700,000. *Strychnine should be tasted with extreme caution.* Permanent in the air. Soluble in 6400 parts of water, 110 parts of alcohol, 5500 parts of ether, 6 parts of chloroform, 150 parts of benzene, and in 180 parts of amyl alcohol at 25° C. (77° F.); soluble in 3000 parts of water at 80° C. (176° F.), and in 28 parts of alcohol at 60° C. (140° F.). Upon ignition, it is consumed, leaving no residue. No coloration is produced with nitric or sulphuric acid, but a drop of the latter and a grain of potassium bichromate, added to a crystal of strychnine upon a porcelain plate, yields a beautiful violet, changing into purplish-red and cherry-red, and finally to orange or yellow.

Dose.—Same as strychnine sulphate or nitrate (minimum quantities), which are preferable on account of their greater solubility.

STRYCHNINÆ SULPHAS. Strychnine Sulphate.
$(C_{21}H_{22}\ N_2O_2)_2\ H_2SO_4 + 5\ H_2O$. (U. S. & B. P.)

Derivation.—Made by the action of sulphuric acid on strychnine.

Properties.—Colorless, or white, prismatic crystals, odorless, and having an intensely bitter taste, perceptible in highly dilute (1 in

700,000) solution. Efflorescent in dry air. Soluble in 31 parts of water and in 65 parts of alcohol; 2 parts of boiling water and in 8.5 parts of boiling alcohol. Almost insoluble in ether. Upon ignition, it is consumed, leaving no residue. Sulphuric acid should produce no color with strychnine sulphate, but on adding a fragment of potassium dichromate, a blue color should be formed, changing to deep violet, then to purplish-red, cherry-red, and finally to orange or yellow. Sulphuric acid containing 1 per cent. of ammonium vanadate produces a deep violet-blue color, changing to deep purple, and finally to cherry-red.

Dose.—H., gr.ss.-i.ss. (.03-.09); C., gr.i.-iii. (.06-.18); Sh., gr. ¼-½ (.015-.03); D., gr. $\frac{1}{120}$-$\frac{1}{40}$ (.0005-.0015). The smaller doses are to be used when strychnine is given subcutaneously.

Strychninæ Nitras.—Strychnine Nitrate, occurring in colorless, odorless, glistening needles, is now official. Has very bitter taste; soluble in 42 parts of water. Dose same as Strychnine Sulphate. *Strychninæ Hydrochloridum* (B. P.). Dose same as Strychnine Sulphate.

The dose of strychnine should be proportioned to the weight in the case of all animals, but more particularly dogs. Otherwise, convulsive attacks or a fatal result may occur. The dose can be accurately determined, according to Feser, by the following data:

Dose per kilo (2lbs. 3oz. 119.9gr. avoirdupois) live weight:

Horse, sheep and cattle.....	.0001-.0002	(gr.$\frac{1}{600}$-$\frac{1}{300}$)
Swine	.0002-.0003	(gr.$\frac{1}{300}$-$\frac{1}{200}$)
Dogs	.0001	(gr.$\frac{1}{600}$)

In accordance with the foregoing figures, the dose for the

Horse	weighing	1,000	lbs. is	.045-.09	(gr.$\frac{3}{4}$-$1\frac{1}{2}$)
Dog	"	100	" "	.0045	(gr.$\frac{1}{13}$)
"	"	50	" "	.00225	(gr.$\frac{1}{26}$)
"	"	25	" "	.00112	(gr.$\frac{1}{52}$)
"	"	10	" "	.00045	(gr.$\frac{1}{133}$)

Moreover, these doses may be given every three hours without producing poison by their cumulative action. Notwithstanding the foregoing figures, caution should be exercised in prescribing strychnine to dogs, as these animals appear sometimes extremely susceptible to strychnine, and it is therefore advisable to begin with a minimum dose (gr. $\frac{1}{120}$) in small animals.

The dose of one grain should not be ordinarily exceeded in the case of horses, as one and one-half grains proved fatal in an exceptional case. If animals are depressed by disease, poison, or shock,

they will often bear much larger doses than could ordinarily be administered with safety.

Action External.—Strychnine is a powerful antiseptic, but is of no practical value on account of its poisonous properties. Brucine is a local anæsthetic.

Action Internal.—Digestive Tract.—Strychnine and nux vomica act as bitter stomachics in increasing vascularity, appetite, gastric secretion and motion. In addition to this they improve the local tone of the alimentary canal; probably by exciting the various spinal centres. Strychnine also stimulates the intestinal muscular tunic and therefore increases peristaltic action.

Circulation.—Experiments on animals show that the chief action of strychnine on the circulation consists in stimulation of the vasomotor centres with slight increase of blood pressure. Clinically, however, strychnine appears to accelerate and strengthen the heart-beat and this is thought to result from excitation of the cardiac muscle. There is, however, no experimental evidence to show that medicinal doses of strychnine influences directly the mammalian heart (Cushny). The heart is accelerated by muscular activity in convulsions. Very large doses slow and weaken the heart. In poisoning, blood tension is still further enhanced through asphyxia and muscular movements occasioned by convulsions forcing the blood out of the abdomen.

Nervous System and Muscles.—The effect of strychnine, which stands preëminent before all others, consists in the production of greatly exaggerated reflex action. Under its influence slight sensory stimuli result in the most marked and uncontrollable motor impulses (convulsions). It is proved also that afferent impulses must reach the cord through the sensory tract for convulsions to occur. Section of the spinal cord from the brain in animals shows conclusively that strychnine convulsions are of spinal origin.

Ingenious experiments furthermore indicate that the tract in the spinal cord—which is acted upon to cause increased motor responses to sensory stimuli—is situated between the entrance of the sensory roots into the cord and the motor cells of the inferior cornua. Or, more precisely, the seat of strychnine action appears to be immediately adjoining the afferent side of the inferior cornual cells.

Increased reflex excitability produced by strychnine has been heretofore attributed to the direct stimulating action of the drug on the motor tract of the cord. This is apparently not the case, for, when a solution of strychnine is applied to the cord at the level of the cells controlling the forelegs, and the forelegs are irritated, there is increased contraction of the hind as well as the fore limbs. The motor cells of the hind limbs, in this experiment, are not directly

acted upon by strychnine at all. The action of strychnine on the cord is thought to be indirect.

That in some way it removes the natural resistance to the passage of afferent impulses to the motor cells and therefore a greater force remains to be expended on the motor cells (Cushny). To put it more briefly, strychnine increases the conductivity of the cord for sensory impulses.

In fatal strychnine poisoning general paralysis ensues through depression of the spinal sensory and motor centres. This may be immediate after enormous doses, with absence of convulsions; or appear at the end of fatal poisoning. The motor nerve endings are also paralyzed but this is secondary in mammals to the more important paralysis of the motor and sensory spinal centres. The voluntary muscles and afferent nerves are unaffected by strychnine.

Respiration.—It is probable that strychnine is the most powerful and effective respiratory stimulant we possess. Through its influence the respiratory movements are quickened and strengthened by therapeutic doses. It is likely the action, as upon other spinal centres, is indirect, *i.e.,* the respiratory centres are made to respond more forcibly to sensory stimuli.

Organs of Special Sense.—The sense of sight, smell, hearing and touch is rendered more acute by strychnine.

Elimination.—Strychnine escapes to some extent unchanged, and also as strychnic acid, in the urine. It appears within half an hour of ingestion and may be discovered in the urine from 3 to 8 days thereafter. The greater part of strychnine is probably oxidized in the body. While the drug is not cumulative, in the sense of producing sudden and violent action following its continual use in gradually increasing doses, yet a tolerance for it can not be acquired.

Administration.—For tonic purposes, strychnine may be given to dogs in pills or tablets, and to horses in solution dropped on the tongue. Nux vomica is given to horses upon the food in the form of powder, or in fluidextract upon the tongue; while the tincture is more appropriate for dogs. When large doses of strychnine are used, or an immediate action is desired in acute diseases and emergencies, the alkaloid should be given under the skin.

Toxicology.—One-twentieth of a grain of strychnine nitrate, injected subcutaneously by the writer into a dog weighing 25 lbs., caused uneasiness and excitement, with protrusion of the eye-balls, and in the space of ten minutes, tetanic convulsions. The breathing was shallow and almost imperceptible, the pulse rapid and irregular, the lips were covered with foam, the tail was stiff and extended, the ears laid back, and there was general muscular rigidity, the animal lying on his side in a state of opisthotonos. This condition lasted

about three minutes, and was followed by a period of relaxation. But the slightest noise or irritation of the skin brought on convulsions. The convulsions became less frequent and violent, and ceased altogether within half an hour. The same animal was given gr. $\frac{1}{40}$ of the alkaloid on the following day, but without producing any appreciable result. One-tenth of a grain, given on another day and in the same manner, caused immediate uneasiness and restlessness, and in ten minutes induced a severe convulsion, lasting for three minutes, in which the animal was so rigid that he could be lifted bodily without bending. The ears were drawn back, the limbs were extended and stiff, the tail was straight and rigid, and there was twitching of the muscles of the jaw and limbs. The corners of the mouth were drawn back (risus sardonicus), the mouth was covered with foam, and there was some trismus. The breathing was nearly suppressed, owing to tetanic spasm of the respiratory muscles. Following this convulsion, the jaw dropped, the muscles relaxed and another attack could not be produced by noises or external irritation. Some twitching of the temporal muscles persisted. Evidently the second stage of poisoning had ensued, and the motor nerves and cells of the inferior cornua had become paralyzed. Death occurred in general paralysis within half an hour, and without any recurrence of convulsions or tetanic condition. Death takes place more commonly in strychnine poisoning from asphyxia, during a convulsion, and is caused by spasm of the respiratory muscles, or, more rarely, by spasm of the glottis. Sometimes death ensues, after enormous doses, in general paralysis from depression of the spinal nerve centres—without the occurrence of convulsions. Rarely death occurs from exhaustion between the paroxysms. When strychnine is given medicinally in large doses the appearance of restlessness, excitement, and muscular twitchings, should warn one of the danger of approaching poisoning.

The lethal dose for dogs has been set at gr. $\frac{1}{6}$-gr. $\frac{1}{3}$ (Kaufmann). This is much too large, as evidenced by the experiment mentioned above. The fatal amount varies greatly in accordance with the weight of an animal; probably less than gr. $\frac{1}{20}$ by the mouth would kill toy terriers, and cases are reported where they have been destroyed by gr. $\frac{1}{60}$ of the alkaloid. The therapeutic dose should therefore be proportioned as advised, to the weight of the animal. Five to eight grains of nux vomica will kill dogs.

The minimum fatal dose of strychnine for man is one-half a grain. Usually four to seven grains constitute a lethal quantity, but recovery has ensued following the ingestion of 22 grains, after a full meal.

Horses.—The toxic symptoms in horses resemble those already described in the dog. They do not appear for some time (20 min-

utes to 6 hours), depending on the rapidity of absorption when the drug is swallowed, and include excitement, muscular spasm and convulsions, increased frequency of the pulse, and difficult respiration. Death occurs in convulsions or in the interim between them. The minimum fatal dose of strychnine, when given under the skin, is about 1½ to 3 grains, and when swallowed, 3 to 5 grains of the alkaloid, or 1 to 2 ounces of nux vomica.

Cattle are similarly affected with horses and dogs. There are exhibited muscular spasms, frequent pulse, difficult respiration, sensitiveness to light, sounds and external stimuli, protrusion of the eyeballs and convulsions. The fatal dose, by the mouth, varies greatly owing to difficulty of absorption in the complicated and capacious digestive apparatus of these ruminants. This is true of all medicines. When given under the skin, the lethal dose is a little larger than that for horses. The fatal dose for swine is said to be from gr. ⅙-gr. ¾. Chickens are comparatively insusceptible; also guinea pigs and some monkeys.

Strychnine poisoning differs from tetanus in the fact that muscular rigidity is continuous in the latter, but disappears to a considerable degree, if not completely, in the periods between the convulsions, in the case of strychnine poisoning. Moreover, in tetanus the body and limbs are less, and the jaw more affected; while in strychnine poisoning the condition is reversed.

Treatment.—The treatment embraces the use of chemical antidotes, as iodine or its salts, or tannic acid; animal charcoal and emetics or the stomach tube, before absorption has occurred. The best physiological antidote is chloral in large doses per rectum. Chloroform and nitrite of amyl may also be given by inhalation, and quiet and rest enforced. Artificial respiration is of service in paralysis, but not in convulsions, unless air be forcibly driven into the trachea through a canula. Calabar bean and gelsemium both depress the inferior cornua, but neither are of much value in strychnine poisoning.

Post-Mortem Appearances.—These are simply those of asphyxia, with the usual congestive lesions and dark fluid blood, except that spinal hyperemia is observed.

Uses Internal.—The indications for the employment of strychnine may be directly deduced from its physiological actions. The indications are as follows:

1. To stimulate the respiratory and vasomotor centres and nervous system.

2. To stimulate the spinal cord; more particularly the motor cells of the inferior cornua.

3. To stimulate appetite, digestion, and intestinal peristalsis in atonic conditions.

4. To destroy dogs and other small animals.

1. Strychnine is a good remedy to stimulate the heart, respiration, vasomotor centres and nervous system, and to promote appetite and digestion in acute diseases. It is commonly employed in the treatment of pneumonia and influenza and in all acute diseases when the necessity arises. Strychnine should not be used continuously, but only to bridge over a period of weakness or collapse, and it is not indicated in pneumonia until evidence of heart weakness arises. It should be realized, however, that strychnine is not in any way comparable to digitalis as a heart stimulant and in heart weakness in pneumonia, or other diseases, digitalis is infinitely preferable. Strychnine is useful in influenza by counteracting nervous depression and improving the appetite and digestion. In collapse and shock, following surgical operations, or in ether, chloroform and opium poisoning, strychnine is usually prescribed as a cardiac and respiratory stimulant, given in large doses subcutaneously. In surgical shock Crile finds strychnine of no value and it is undoubtedly true that adrenalin is much more effective. Strychnine has been popularly regarded as *the* heart stimulant, but the fashion of so regarding and using it is departing since physiological experiments do not substantiate this view. While Cabot does not find it useful in raising blood pressure in disease yet strychnine is undoubtedly of service in some cases of chronic cardiac trouble. The alkaloid has proved extremely serviceable in chronic bronchitis, emphysema, and in that combination of these disorders, often associated with asthma and known as "broken wind" or "heaves," in horses. It is also useful in asthma and chronic bronchitis of dogs.

The beneficial effect in these diseases is explained by the stimulating action of the drug on the respiratory centres, and the favorable influence exerted on digestion. Strychnine is also appropriate in convalescence from acute diseases for the same reason.

2. In mild cases of chorea in dogs, strychnine is prescribed to advantage with Fowler's solution. In accordance with its physiological action, strychnine is indicated in various paralyses of spinal origin, but should not be used where there is irritation or inflammation of the spinal motor tract. It is employed in hemiplegia and paraplegia, resulting from hæmorrhage, after the lapse of several weeks, when irritation produced by the clot has passed away. Strychnine is said to be efficacious in the after-treatment of cerebrospinal meningitis of horses, and also in the paraplegia of cattle (from parturient fever, and in the paraplegia coming on before parturition in weak cows and not disappearing after labor) and that

of dogs resulting from various and often undiscovered causes. Strychnine is serviceable in the paralysis of lead poisoning, and in that form caused by traumatism or toxemia following influenza, distemper in dogs, and rheumatism. When injected into the muscular tissue, the alkaloid is believed to stimulate the peripheral nerves and muscular fibres, and is employed with benefit in localized paralyses affecting groups of muscles before atrophy has occurred, as in "roaring" in horses.

Either retention or incontinence of urine, resulting from atony or paralysis of the bladder, may be relieved by strychnine; also prolapse of the rectum induced by similar causes. Strychnine has proved curative in some cases of amaurosis, when injected in the region of the temple.

3. Strychnine or nux vomica, associated with iron and arsenic, form the most generally satisfactory tonic combination for the horse and dog, particularly with reference to the digestion. Atonic forms of indigestion and constipation, the accompaniments of anemia, are those amenable to the influence of the drug, which stimulates peristalsis, and therefore hinders fermentation, prevents relaxation, and so over-secretion from loss of vascular tone.

Strychnine is a valuable remedy in overloaded rumen and omasum, and chronic tympanitis of cattle; or in overloaded and impacted large intestines of the horse. It should be given subcutaneously in these conditions, and frequently in combination with pilocarpine and eserine or arecoline.

Constipation, and, on the other hand, diarrhœa, are benefited by strychnine when they are due to atony of the intestinal muscular coat. It is more commonly in the former disorder that the drug finds its usefulness. The aloin, strychnine and belladonna pills, with cascara sagrada, are useful in habitual constipation in dogs, but the weaker formula, containing gr. $\frac{1}{120}$ of strychnine, should be employed. The value and application of strychnine in anorexia and atonic digestive disorders has been sufficiently treated above.

4. There is no more convenient, certain or humane agent for destroying dogs and cats and other small animals than strychnine injected into the gluteal muscles (gr. ss. to gr. i.).

Death occurs instantaneously without struggling, pain or convulsions, and in less than a minute in most cases.

Class 2.—Depressing the Inferior Cornua.

Physostigma. Physostigma. (U. S. P.)

Synonym.—Physostigmatis semen, B. P.; Calabar or ordeal bean, faba physostigmatis, S. faba Calabarica, E. The ripe seed of *Physostigma venenosum* Balfour (Fam. *Leguminosæ*), yielding, when assayed by the process given below, not less than 0.15 per cent. of alkaloids soluble in ether.

Habitat.—Calabar and the region of the mouth of the Niger, in Western Africa.

Description.—Oblong, somewhat reniform, 15 to 30 Mm. long, 10 to 15 Mm. thick; externally reddish- or chocolate-brown, smooth, somewhat roughened near the brownish-black groove which extends almost the entire length of the convex edge, its reddish, rounded margins elevated and somewhat thickened; embryo whitish, with a short, curved hypocotyl and two large, concavo-convex cotyledons; having a bean-like and heavy odor when crushed; taste at first starchy, afterwards acrid.

Constituents.—The principal constituent is the alkaloid physostigmine, or eserine. There are also the alkaloids calabarine, a product resulting from the decomposition of eserine, and eseridine, similar to action in eserine, but weaker; and a neutral principle, physosterin, resembling cholesterine.

Calabar Bean Dose.—H., gr.xv.-xxx. (1.-2.); D., gr. ¼-i. (.015-.06).

The official preparations are the extract and tincture of physostigma, but physostigmine is solely used in veterinary medicine, since it is more certain and generally free from calabarine, which produces, in toxic doses, a tetanic condition followed by paralysis.

Physostigminæ Salicylas. Physostigmine Salicylate. $C_{15}N_{21}N_3O_2C_7H_6O_3$. (U. S. P.)

Synonym.—Eserine salicylate. The salicylate of an alkaloid obtained from physostigma.

Derivation.—Physostigmine is obtained from the alcoholic extract of Calabar bean by dissolving the extract in water, adding sodium bicarbonate, shaking the mixture with ether, and evaporating the ethereal liquid. The salicylate of the alkaloid—the most stable salt—is made by adding physostigmine to a solution of salicylic acid in boiling distilled water, when the salt crystallizes on cooling.

Properties.—Colorless, or faintly-yellowish, shining, acicular, or short, columnar crystals; odorless, and having a bitter taste. Soluble in 72.5 parts of water, and in 12.7 parts of alcohol; in 30 parts of boiling water, and very soluble in boiling alcohol. (U. S. P.)

Dose.—H. & C., gr.i.ss.-iii (.09-.18); D., gr. $\frac{1}{100}$-$\frac{1}{30}$ (.0006-.002).

Given usually subcutaneously, intravenously or intratracheally to horses.

PHYSOSTIGMINÆ SULPHAS. Physostigmine Sulphate. (U. S. & B. P.)

Synonym.—Eserine sulphate.

The sulphate of an alkaloid obtained from physostigma.

Properties.—A white, or yellowish-white, micro-crystalline powder, odorless, and having a bitter taste. It is very deliquescent when exposed to moist air, and gradually turns reddish by exposure to air and light. Very soluble in water, chloroform and in alcohol.

Dose.—H. & C., by the mouth, gr. 1½-3 (.09-.18); D., gr. $\frac{1}{60}$-$\frac{1}{10}$ (.001-.006); H., subcut., gr. 1-1½ (.06-.09); intratracheally, gr. ½ (.03); foals and calves, subcut., gr. $\frac{1}{12}$-⅙ (.005-.002); D., subcut., gr. $\frac{1}{100}$-$\frac{1}{30}$ (.0006-.002).

Given usually subcutaneously, intravenously or intratracheally to horses.

PHYSOSTIGMINE.

Action Internal.—Alimentary Tract.—The flow of saliva is at first stimulated, whether by direct excitation of the salivary cells or not, is undetermined. Salivation ceases when the gland is deprived of blood by general vascular contraction. The peristaltic action of the stomach and bowels is increased by the direct local action of the alkaloid on the muscles or ganglia of their walls. There are three stages, in reference to this action, observed in poisoning. First, there is stimulation of peristaltic action, then tetanic contraction and diminution of the intestinal calibre, and finally relaxation and dilatation of the bowels. The secretions in the digestive tract are augmented by the expulsion of considerable mucus per rectum. When the alkaloid is given to horses, under the skin, within the trachea or intravenously, defecation and expulsion of gas commonly occurs in the space of half an hour, occasionally in a few minutes, and is often considerable in amount (11-20 lbs. of fæces).

Circulation.—Eserine is readily absorbed, but exerts no influence on the blood. Moderate doses render the cardiac pulsations

slower and more forcible, and increase vascular tension. Large toxic doses cause the heart to beat more rapidly and less forcibly. The first effect is due probably to stimulation of the peripheral vagi and heart muscle, and possibly the involuntary muscular fibres in the vessel walls. The second phenomenon follows depression of the heart and peripheral vagi, and terminates in cardiac paralysis and diastolic arrest. The action on the circulation is entirely subordinate to the influence of the drug upon the nervous system, and is unimportant from a therapeutical standpoint.

Nervous System and Muscles.—The essential physiological action of physostigmine consists in depressing the cells of the inferior cornua. This has been abundantly and directly proved by application of the alkaloid to the spinal cord. The superior columns are finally depressed; perception of pain is wanting, but that of touch persists. The sensory nerves are not affected, and the motor nerve trunks but slightly. The muscular tremors are due to stimulation of the voluntary muscles themselves, or to the motor nerve endings. These are characteristic of physostigma poisoning in animals, but are not so frequently observed in man. Calabarine may be present in old preparations of physostigma, from decomposition of physostigmine, and acts like strychnine on the spinal cord. In poisoning by such, calabarine may induce convulsions. The involuntary muscles throughout the body are stimulated, including those of the stomach, intestines, bronchial tubes, heart, blood vessels(?), spleen, uterus, bladder and iris. In the case of some of these organs, it has not been decided whether the muscles themselves, or the motor nerve terminations, are affected.

Respiration.—The respiration is not disturbed by medicinal doses. Toxic quantities at first quicken, and then retard the respiratory movements, and death occurs from asphyxia, before cessation of the heart, owing to paralysis of the medullary and spinal respiratory centres. The acceleration of breathing is due to the stimulation of the pulmonary vagal endings, and possibly to the constriction of the unstriped muscle of the bronchial tubes.

Secretions.—Secretion is generally increased, including that of the salivary, gastric, intestinal, sudoriparous and lachrymal glands. In this respect eserine is antagonistic to atropine.

Eye.—Physostigmine is a myotic, applied locally or administered internally. Intraocular tension is diminished and there is spasm of accommodation (see footnote, p. 40). In all probability contraction of the pupil is brought about by stimulation of the circular muscular fibres of the iris or of the oculomotor nerve endings. Eserine is thus directly antagonistic to atropine in its effect upon the eye, but they resemble each other in that they both exert a local

action and do not affect the irides of birds. Enormous doses of physostigmine paralyze the oculomotor nerves and dilate the pupil.

Elimination.—Eserine is rapidly absorbed and eliminated, mainly by the urine, but also in the other secretions.

Toxicology.—Physostigma has been called "ordeal bean," because native Africans suspected of crime are given the crude drug. Vomiting it, they are proved innocent and survive the ordeal. Retaining it, they die, and so are properly and primitively punished. Animals poisoned by Calabar bean exhibit muscular tremors which continue throughout the toxic period, and are often so violent as to simulate convulsions. Soon there is loss of muscular power and the animal falls or lies down. The respiration becomes rapid, labored, and sterterous; the pulse is increased in frequency by large toxic doses, and the temperature slightly elevated. There are salivation and sweating. The pupil is sometimes contracted and, when enormous lethal doses have been injected, dilated. Vomiting occurs in animals capable of the act, and loud peristaltic noises are heard, followed by the expulsion of feces, mucus and flatus, with colicky pains and tenesmus. Reflex action is diminished or abolished, but sensation is preserved until late in the toxic period. The muscles are completely relaxed and powerless, notwithstanding the tremors which afflict them. The breathing becomes weak and irregular, and death occurs from respiratory failure.

In experiments of Winslow and Muir conducted independently and at different times the following cases may be of interest:

A healthy gelding, weighing 1,050 lbs., was strapped upon the dissecting table and given three grains of eserine sulphate intrajugularly. Within a few minutes slight muscular tremors appeared in the neck; the pulse rose to 120, the respiration was 24, and the temperature normal. There was slight sweating. The pulse soon fell to 60, and was strong and hard, while the respiration became rapid and labored. No other symptoms developing within twenty-five minutes after the first dose, three grains of the alkaloid were administered in the same manner as before. The pulse became more frequent (78), the respiration (48) was difficult, and the muscular tremors increased in violence till they resembled convulsions. Sweating was profuse, while saliva dropped freely from the mouth. The respiration and pulse were now reduced in frequency and became weaker. The pupils were unaffected, but the eyes were staring. Half an hour after the second dose increased peristaltic action was evidenced by loud noises and the expulsion of gas and dung. Recovery began in two hours from the exhibition of the second dose. It is possible that the severe muscular tremors were caused by contamination of the eserine with calabarine, as the former was not a fresh preparation. An aged express horse, suffering for a week from impaction of the colon, was given twelve minims of a commercial extract of calabar bean. He fell down almost immediately, perspired freely, exhibited muscular tremors, and expired within a few minutes. The

writer is unable to state the minimum fatal dose for horses, but eserine should be used with caution in weak subjects.—WINSLOW.

A gelding, 800 lbs., poorly nourished, temperature normal, pulse 60, was given physostigmine sulphate gr. 1½ (0.1) in ½ drachm of water intrajugularly. Muscular tremors and colic came on in seven minutes; in eleven minutes defæcation occurred, the heart became more rapid and colic increased. Passages from the bowels were frequent for two hours—about fifteen in all—the feces weighing twenty pounds in the aggregate. All symptoms abated after three hours from the time of receiving the drug.—MUIR.*

A gelding, thirteen years old, in good condition and weighing 1,205 lbs., temperature and pulse normal, was given 3 grains (0.18) of eserine sulphate under the skin. After thirty-two minutes elapsed, defecation began and continued with the expulsion of considerable mucus and flatus until six passages had occurred within one hour and twenty minutes. During this time the pulse had increased in frequency and the animal was restless and pawing the ground. An hour and a half after the first dose, a second dose of 3 grains (0.18) was given in the same way. In twenty minutes muscular tremors and weakness became marked, for the first time, and great distress was evident, the patient appearing to be in much pain; the respiration short, jerky and labored, and nostrils distended and working. The evacuations continued until twenty-three had been passed from the time of receiving the first dose and until one and one-half hours after the second dose. The feces were quite liquid and contained much mucus and during passage were attended with considerable straining. The weight of feces aggregated 17 lbs. Four hours after the last dose all symptoms disappeared.—MUIR.*

Summary.—Full medicinal doses of physostigmine (gr. 1½-3), given subcutaneously or intravenously, produce slight to considerable colic, increased peristalsis and mucus secretion, muscular tremors and weakness, and frequent defecation—beginning in ten to twelve minutes after intravenous use, about thirty minutes or more after injection under the skin—and being twice as copious when the former mode of administration is employed than after the latter. Moreover, the disagreeable accompaniments of purging last twice as long (five hours) after the hypodermic method than after the intravenous injection (two and a half hours). Muir deduces from his experiments that physostigmine is a safe and active cathartic for the horse and is free from evil after-effects; that along with increased peristalsis and mucous evacuation from the bowels there are colic and more rapid pulse-rate with muscular tremors and weakness; that eserine acts more quickly and effectively when injected into the external jugular vein, and that it may be safely given in this manner in a dose of 3 grains dissolved in 30 minims of water, to horses in fair condition and of average weight.

* Jour. of Comp. Med. and Vet. Archives, Jan. and Feb., 1899.

The toxic line is closely approached, however, when physostigmine is used in this way, and we should be careful not to cross it by exceeding the dose. Barium chloride acts as rapidly and without the unpleasant accompaniments of purgation caused by eserine, so that the former is generally preferable as a cathartic for use by the intravenous method.

The minimum fatal dose is stated to be from gr. $\frac{1}{15}$-$\frac{1}{12}$ for dogs, and gr. $\frac{1}{30}$-$\frac{1}{20}$ for cats. The treatment should be pursued with emetics, or the stomach tube, and the antidote, atropine. The latter will prevent death in rabbits when given five minutes after the administration of three times a minimum fatal dose. Atropine should be given under the skin, together with alcoholic stimulants, digitalis, and ammonia by the mouth. Artificial respiration should be practised and external heat applied. The essential action of atropine in antagonizing eserine, consists in stimulation of the respiratory centres, while it depresses the peripheral cardiac vagi, and so, to a certain extent, counteracts the primary influence of eserine on the heart. Large doses of atropine may only exaggerate the secondary depression of eserine upon the peripheral vagi in the heart, and so hasten a fatal result. Strychnine is antagonistic to eserine in stimulating the respiratory centres and inferior cornua.

Uses External.—Physostigmine has been injected empirically, but it is asserted with good results, into chronic dropsical effusions of joints and bursæ of tendons in horses, after removal of the fluid by aspiration. From .05-.1 gm. is used, dissolved in 5.-10. gm. of sterile water; and this treatment is followed by cold applications for several days afterwards.

Uses Internal.—Three physiological actions of eserine are put to therapeutical uses.

1. The myotic action on the eye.
2. Stimulation of the involuntary muscles.
3. Depression of the inferior cornua.

1. *Eserine is useful, in alternation with atropine, to break up adhesions to the iris; to lessen intraocular tension in glaucoma; and to prevent prolapse of the iris and staphyloma, after wounds and ulcers of the cornea. It is also employed to contract the pupil and shut out the light in photophobia, and to antagonize the influence of atropine on the eye. The action of eserine is, however, not nearly so powerful or persistent as that of atropine on the eye, and is somewhat painful. It is employed in 1 per cent. solution.

2. Physostigmine is mainly of value for its action in rapidly stimulating the unstriated muscles of the alimentary canal. In

*See page 40.

obstinate constipation of horses it is particularly useful; 1 gr. of eserine sulphate being given subcutaneously or intravenously with 3 grs. of pilocarpine sulphate; the latter to increase the intestinal secretions. Strychnine sulphate (gr. 1) may be added to counteract the depressing action of eserine on the respiratory centres and inferior cornua.

Physostigmine, in combination with pilocarpine, is serviceable for its speedy action in flatulent colic and impaction of the cecum, colon, and rectum in horses, and has been employed to expel calculi and foreign bodies from the intestines.

Physostigmine is contraindicated in spasmodic colic, when it may increase the trouble by exciting intense peristaltic contractions. Its employment is also attended with some danger in overloaded or greatly distended stomach or bowels, in view of possible rupture of these organs. The drug, like other purgatives, may aggravate the damage produced by twist or intussusception. In twist of the pelvic flexure of the colon in the horse, commonly mistaken for enteritis, eserine is often life-saving and *the* remedy at our command.

In atonic conditions of the stomach and bowels, and in indigestion due to chronic intestinal catarrh, small and repeated doses of eserine are sometimes of benefit. In cattle, eserine (gr.-i.) and pilocarpine (gr.-iii.) subcutaneously are of great value in impaction of the rumen and omasum, in acute gastritis, and in parturient apoplexy, to quickly empty the digestive canal. Eserine is sometimes given subcutaneously to foals (gr. $\frac{1}{12}$-$\frac{1}{6}$) for retention of meconium. It is effective in obstinate constipation of dogs given by the mouth (gr. $\frac{1}{60}$-$\frac{1}{12}$) in pill, twice daily.

Eserine has been employed in chronic bronchitis, asthma and emphysema, to improve the tone of the bronchial mucous membranes and expel secretions.

3. Eserine is one of the drugs commonly used in the treatment of tetanus in human and veterinary practice, with only a moderate degree of success. It must be employed early, given every three or four hours, and pushed to the physiological limit. Chorea and epilepsy have been treated with eserine without any pathological basis, as far as epilepsy is concerned, and with little therapeutic advantage in either instance. In some cases of paraplegia, resulting from myelitis, a favorable effect has been obtained in man. Eserine is an appropriate purgative (hypodermatically) in acute encephalitis. Eserine has been used in strychnine poisoning, but is inferior to chloral bromides and anesthetics, and while it is antagonistic to a certain extent, and alters the character of strychnine convulsions, yet animals die more quickly when poisoned by both strychnine and eserine, than by strychnine alone.

GELSEMIUM. Gelsemium. (U. S. & B. P.)

Synonym.—Radix gelsemii, yellow jessamine, E.; racine de jasmin jaune, Fr.; gelber jasmin-wurzel, G. The dried rhizome and roots of *Gelsemium sempervirens* (Linné) Aiton filius (Fam. *Loganiaceæ*).

Habitat.—Southern United States.

Description.—Cylindrical, usually in cut pieces of variable length, from 5 to 20, or even 30, Mm. in diameter; externally light yellowish-brown, with purplish-brown longitudinal lines; fracture of the rhizome splintery, the roots breaking with one-half the fracture transverse, the other half oblique or short-splintery; bark about 1 Mm. thick; wood pale yellow, porous, but tough, with numerous distinct medullary rays, in the rhizome excentric, and with four groups of internal phloem; odor pronounced, characteristic; taste slightly aromatic, bitter.

Constituents.—The most important is the first alkaloid. 1. Gelsemine, $C_{54}H_{69}N_4O_{12}$. A colorless, crystallizable, bitter principle, soluble in alcohol and ether, and slightly in water. 2. Gelseminine, a brown, amorphous, bitter alkaloid. 3. Gelseminic acid. 4. A volatile oil.

Dose.—H., 3 i.-ii. (4.-8.); D., gr.v.-x. (.3-.6).

PREPARATIONS.

Fluidextractum Gelsemii. Fluidextract of Gelsemium. (U. S. P.)

Made by maceration, percolation and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—H., 3 i.-ii. (4.-8.); D., ♏v.-x. (.3-.6).

Tinctura Gelsemii. Tincture of Gelsemium. (U. S. & B. P.)

Gelsemium, 100; alcohol and water to make 1,000. Made by maceration and percolation. (U. S. P.)

Dose.—H., ʒ ss.-i. (15.-30.); D., ♏xv.-ʒ i. (1.-4.).

Gelsemina. Gelsemine.

(Non-official and uncertain in strength.)

Dose.—H., gr. ¼-½ (.015-.03); D., gr. 1/60-1/30 (.001-.002).

Action External.—None.

Action Internal.—Gelsemium exerts no action on the digestive apparatus, or on the blood, after its absorption; neither does it affect the circulation in medicinal doses, but in toxic quantities it directly depresses the heart. The influence of the drug on the vasomotor system is unknown.

Nervous System and Muscles.—The prominent effect of gelsemium is directed on the nervous system, as evidenced by paralysis and convulsions after large doses. Both the convulsant and paralyzant actions are of spinal origin. That the convulsions are not cerebral is shown by the fact that they occur below the point of section in mammals (under the influence of the drug), with divided spinal cord. That they are not peripheral is proved by their occurrence in the hind extremities when the posterior aorta is tied before the animal is poisoned. The paralyzant action of gelsemium is due to direct depression of the cells of the inferior cornua, and this is followed, in the later stages of poisoning, by depression of the motor nerve endings and spinal sensory tract, with general anesthesia.

The cause of the secondary convulsions is undetermined. A tetanizing principle in gelsemium, antagonistic to gelsemine, such as we find in physostigma, has been thought to be the cause of the convulsions. The muscles, motor (except those of the face) and sensory nerves are unaffected by gelsemium.

Respiration.—Gelsemium, in toxic doses, progressively weakens and paralyzes the medullary and spinal respiratory centres, and death occurs from asphyxia.

Eye.—In poisoning, in animals, there is dilatation of the pupil produced in the latest stages of the toxic period. In man, there is in addition to this, paralysis and drooping of the eyelids (ptosis), and paralysis of the recti muscles with strabismus. These symptoms have been attributed with apparent reason to paralysis of the motor cells in the floor of the fourth ventricle and aqueduct of Sylvius, since they are a prolongation of the spinal motor tract. As the pupil is dilated, however, by the application of much smaller doses than are required by the mouth, it seems probable that mydriasis results from local paralysis of the oculomotor nerve endings.

Toxicology.—Poisoning in animals is exhibited by muscular weakness, especially in the fore legs, staggering gait and falling. These symptoms are followed by convulsive movements of the muscles of the head, fore legs, and sometimes of the hind legs. The respiration is slow and difficult, the pulse feeble; temperature is reduced, and there is sweating. Consciousness is preserved until the occurrence of asphyxia. Death takes place from respiratory failure, with almost simultaneous cardiac arrest. Morphine subcutaneously has proved a successful antidote. Respiratory and heart stimulants should be employed in poisoning by gelsemium, such as strychnine, atropine, alcohol, and digitalis, together with artificial respiration, after evacuation of the stomach.

Uses.—Gelsemium possesses little value in veterinary medicine. There is no therapeutic indication for gelsemium which cannot be filled to better advantage by some other remedy. Thus, gelsemium has been employed as a cardiac depressant and antipyretic in acute diseases (pneumonia and pleurisy), but its other actions are disadvantageous and it is inferior to aconite, veratrum viride, or the modern antipyretics. In spasmodic diseases, irritable cough, vesical irritation, tetanus, chorea, etc., it is less satisfactory as a motor depressant than opium, belladonna, chloral, and bromides. Zuill, however, reports very successful results in horses from gelsemine (.08 Gm.) in tetanus. The dose should be given under the skin every half hour till muscular relaxation occurs. The drug has been used considerably to relieve rheumatic and neuralgic pains, but these succumb more readily to opium, coal tar products, etc. As a mydriatic, gelsemine is not to be compared with atropine for general purposes, but its action is more transient. A solution (gr. 8-℥ i.) is instilled (in man) in drop doses every fifteen minutes for one hour, and then every thirty minutes for two hours, to secure wide dilatation of the pupil; or discs, containing gr. $\frac{1}{300}$ of gelsemine (with gelatine) are used for application to the eye.

SECTION III.—DRUGS ACTING CHIEFLY ON THE MOTOR NERVES.

Class 1.—Depressing the Motor Nerves.

TABACUM. Tobacco.

Synonym.—Tabaci folia, B. P.

The commercial dried leaves of Nicotiana Tabacum Linné (nat. ord. solanaceæ).

Habitat.—Tropical America. Cultivated in various temperate and tropical parts of the earth.

Description.—The leaves are up to 50 Cm. long, oval or ovate-lanceolate, acute, entire, brown, friable, glandular-hairy, of a heavy, peculiar odor and a nauseous, bitter and acrid taste.

Constituents.—Chiefly nicotine, C_{10} H_{14} N_2 (0.7-5.-11. per cent.). A colorless, volatile, oily alkaloid, resembling tobacco in odor and taste. Freely soluble in alcohol and ether; less so in water. Nicotine is decomposed by heat and therefore tobacco smoke contains little of it, but in its stead, pyridine, C_5H_5N, and various

allied alkaloids, viz.; picoline, C_6H_7N; lutidine, C_7H_9N; rubidine, $C_{11}H_{17}N$; coridine, $C_{10}H_{15}N$; parvoline, $C_9H_{13}N$; and collidine, $C_8H_{11}N$; together with small amounts of sulphur, creosote, acetic and hydrocyanic acids and carbon compounds. Pyridine resembles nicotine in depressing the central nervous system and motor nerves and in paralyzing respiration, and is said to be formed more in pipe smoke, while, in the smoke of cigars, the less harmful collodine is produced by dry distillation. Nicotine exists to a very slight degree in Turkish tobacco.

Dose.—Nicotine, H. & C., gr. $\frac{1}{60}$-$\frac{1}{20}$ (.001-.003).

ACTION OF TOBACCO AND NICOTINE.

Action External.—Tobacco is a local anodyne, antiseptic and parasiticide.

Action Internal.—Digestive Tract.—The physiological effect of tobacco is due to nicotine. Nicotine increases peristaltic action and, in large doses, causes tetanic spasm of the intestines, even when it is injected into the blood. In toxic quantities nicotine is a powerful gastro-intestinal irritant, and produces the usual symptoms of pain, vomiting (in animals capable of the act), purging and collapse.

Circulation.—The action of nicotine on the circulation is complicated. The chief effect is due to primary stimulation of the vagus centre, with slowing of the pulse, followed shortly by depression of this centre and heart muscle with feeble and rapid pulse—after large toxic doses. In the same manner there is a transient stimulation followed by depression of the vasoconstrictor centres with consequent primary rise and subsequent fall in blood tension.

Nervous System and Muscles.—Nicotine acts first to stimulate the reflex excitability of the spinal cord, medulla and hind brain in large doses—but this action is quickly followed by depression and paralysis of the whole central nervous system and motor nerves. The muscles and sensory nerves escape its influence. All sympathetic ganglia are first stimulated and then depressed by nicotine.

Respiration.—The respiratory centres are primarily stimulated but later depressed and paralyzed by fatal doses of nicotine and death occurs through respiratory failure.

Secretions.—The secretions of sweat, saliva and bronchial mucus are at first increased and then diminished by the action of nicotine in stimulating and then depressing the ganglia in the course of the secretory nerves.

Eye.—Nicotine affects the pupil variously. It is transiently dilated in the dog and cat; constricted in the rabbit; and, in man, contraction is followed by dilation. These differences appear to de-

pend upon whether the drug stimulates more the sympathetic (dilation) or the oculomotor (contraction) ganglia.

Elimination.—Nicotine is in part destroyed by the liver. It is also eliminated chiefly by the kidneys but also is found in the saliva and sweat.

Toxicology.—Nicotine is one of the most powerful and rapidly acting poisons. When swallowed, it causes, in animals, local irritation and pain in the throat and stomach; muscular tremors and weakness, on account of which the animal falls. These symptoms are followed, first, by severe tonic and clonic convulsions, and then by abolition of voluntary motion and quietude. There are vomiting (in the case of some animals), purging and micturition. The respiration is at first shallow and rapid, but becomes weaker and slower, and death occurs from respiratory failure and general collapse. The pulse is primarily slow and intermittent, but later becomes rapid. The treatment of poisoning consists in evacuation of the stomach; the use of tannic acid; respiratory and heart stimulants, as strychnine, atropine, caffeine, and alcohol; together with external heat and artificial respiration. The minimum lethal dose is about one drachm of tobacco, or one minim of nicotine, for small dogs. For horses, five to ten drops of nicotine or one-half pound of tobacco.

Uses.—Tobacco is not a particularly valuable medicinal agent. Its internal action is often violent, and causes great nausea. Absorption and poisoning may follow its external application in the smaller animals. The drug may be employed for four purposes, as follows:

1. As a local sedative.
2. As a parasiticide.
3. As a motor depressant.
4. As a cathartic.

External.—1. Tobacco is an efficient sedative in decoction (1-40), for relieving pruritus ani and vulvæ. It must be remembered that absorption and poisoning may occur when larger amounts are used externally than can be administered with safety by the mouth.

2. The latter remark applies also to the use of tobacco decoctions in killing parasites on the skin, such as the acari of mange and scab, together with lice and fleas. For sheep with full fleece tobacco is one of the best curative and preventive agents in scab as follows: Manufactured tobacco, 1 lb.; flowers of sulphur, 1 lb.; water, 5 gallons. The tobacco is soaked in cold or tepid water for 24 hours and, on the night before the dipping, the solution is brought to a boil for a minute and the tobacco allowed to remain in it over night. Mix the sulphur in a pail to the consistency of a gruel with

water. Strain and press the liquid out of the tobacco and add it to the sulphur and enough water to make 5 gallons. After dipping, the sheep must be turned into a clean yard or barn to drain.

Internal.—3. Tobacco has been employed as a motor depressant in spasmodic disorders, such as asthma, tetanus (given by the rectum or under the skin), and strychnine poisoning, but it is inferior to, and more dangerous than, other drugs.

4. The Germans prescribe tobacco to stimulate peristalsis in ruminants, in doses of 2 ounces, with one-half pound of common salt and one pound of Glauber's salts for cattle; and for sheep, ½ ounce, with 2 ounces of salt and 3 ounces of Glauber's salts. Tobacco was given formerly in colic and intestinal obstruction, but this use is obsolete. The decoction (1 to 2 per cent.) may be injected into the rectum of horses, in non-toxic quantities, to kill oxyurides and ascarides, and to excite peristalsis and relieve spasm in colic.

Tobacco smoke is sometimes used in the same manner to destroy worms in the lower bowels.

Conium. Conium.

Synonym.—Conii folia, B. P.; hemlock fruit, E.; fruits de grande ciguë, Fr.; schierlingsfrüchte, G.

The full-grown, but unripe fruit of *Conium maculatum* Linné (Fam. *Umbelliferæ*), carefully dried and preserved, and yielding, not less than 0.5 per cent. of coniine. After being kept for more than two years, Conium is unfit for use.

Habitat.—Indigenous to Europe and Asia, but naturalized in the United States.

Description.—Broadly ovoid, greenish-gray, the two carpels of most of the fruits separated, each about 3 Mm. long and about 1.5 Mm. in diameter, ovoid, somewhat curved, the inner, flattened side marked by a deep longitudinal groove, the outer, convex side with five pale yellow, somewhat crenate ribs, the intervening surfaces wrinkled but otherwise smooth; pericarp without oil-tubes; odor slight, but when triturated with a solution of potassium hydroxide, strong, disagreeable, and mouse-like; taste characteristic, disagreeable, afterwards somewhat acrid. Conium fruit resembles carraway and anise seed, but these have oil-tubes or vittæ.

Constituents.—There are two essential principles in conium; conine, or coniine, and methyl-coniine.

1. Conine, $C_8H_{17}N$, is a yellowish, oily, volatile liquid alkaloid, of an odor resembling that of mouse urine, and acrid taste. It is freely soluble in alcohol and ether, and is soluble in 100 parts of water, with which it forms a hydrate. It undergoes decomposition

when exposed to air and heat, and becomes first brown and then resin-like. For this reason the alkaloid is uncertain in its physiological action, but its salts (the hydrobromate and acetate) are more stable and reliable. Conine may be obtained by distillation of the fruit with an alkaline water.

2. Methyl-coniine, C_8H_{19} C N, is a colorless liquid.

3. There is also a nearly inert and crystalline alkaloid, conhydrine.

Incompatibility.—Vegetable acids, caustic alkalies and astringents are incompatible with conium.

Conium Dose.—H. & C., 3 i.-ii. (4.-8.); Sh. & Sw., gr.x.-xx. (.6-1.3); D., gr.ii.-v. (.12-.3).

Coninæ Hydrobromidum.—H. & C., gr. ¾-1½ (.045-.1); Sh. & Sw., gr. ⅕-⅖ (.012-.024); D., gr. ⅓₀-⅑₂ (.002-.005).

Dissolved in alcohol.

PREPARATIONS.

Fluidextractum Conii. Fluidextract of Conium. (U. S. P.)

Made by maceration and percolation with acetic acid and diluted alcohol, and evaporation. Standardized to contain 0.45 gm. of coniine in each 100 cc. of the fluidextract.

Dose.—H. & C., 3 i.-ii. (4.-8.); Sh. & Sw., ♏x.-xx. (.6-1.3); D., ♏ii.-v. (.12-.3).

Succus Conii (B. P.).—H. & C., ʒ ii.-iv; Sh. & Sw., ʒ ss.-i; D. & C., 3 ss.-i.

Tinc. Conii (B. P.).—D. & C., 3 ss.-i.

Ung. Conii (B. P.).

ACTION OF CONIUM AND CONINE.

External.—Conine is an irritant applied to mucous membranes. Conium is thought to act as a local sedative upon raw surfaces. Physiological experiments show that the sensory nerves are but slightly depressed.

Internal.—Circulation.—Conium has little effect upon the digestive apparatus, except in toxic doses, when it may cause irritation, vomiting and diarrhea. It is absorbed and produces primary acceleration of the pulse, probably owing to paralysis of the ganglia of the pneumogastric, followed by a fall in the pulse rate. The action on the circulation is insignificant compared to that on the nerves.

Nervous System and Muscles.—The predominant action of conium consists in paralyzing the voluntary and involuntary muscles, with loss of motion but without loss of consciousness or sensation. That this effect is due to paralysis of the motor nerves has been

proved by poisoning frogs with conium after ligature of the aorta, so that the blood supply of the hind legs was cut off. Failure of motion and reaction to galvanism occurs in the fore legs, but irritation of the paralyzed fore legs causes reflex contraction of the posterior extremities. This experiment shows that the motor nerves are paralyzed in the fore legs, but that the sensory nerves and spinal cord retain their functional activity. The afferent nerves are somewhat depressed by enormous doses. The brain and spinal cord are slightly affected by conium. The convulsions occurring in conium poisoning appear, nevertheless, to be of central origin, although consciousness is retained until the stage of asphyxia. The special senses are somewhat interfered with (sight). The motor cells of the inferior cornua are slightly depressed by methyl-coniine, which influences the cord as well as the motor nerves, but it is considerably less active than conine. The muscles are primarily unaffected.

Eye.—The pupil is dilated (not constantly) and ptosis is observed in poisoning by conium, owing to paralysis of the oculomotor nerve endings. If conine is dropped into the eye, primary contraction, due to reflex irritation, is soon succeeded by dilatation of the pupil.

Respiration.—The spinal and medullary respiratory centres are finally depressed by lethal doses of conium, and this result, together with paralysis of the terminations of the nerves of the diaphragm, causes death by asphyxia.

Elimination.—Conine is excreted by all channels, but mainly in the urine.

Toxicology.—The minimum fatal dose of conium is uncertain, owing to the proneness of the alkaloid to decomposition, and to the volatility and the variable amount contained in the crude drug. A few drops of the alkaloid will kill small cats and dogs. Herbivora, as goats, sheep and horses, are less susceptible than carnivora.

The domestic animals occasionally become accidentally poisoned by eating hemlock at pasture. The symptoms exhibited are dulness, loss of muscular power (at first in the hind legs), stumbling and falling, or lying down. We observe, also, nausea, salivation (sometimes amaurosis), dilatation of the pupil and ptosis, sweating, and often muscular tremors and clonic convulsions. The pulse becomes slow and feeble, the breathing faint, the surface cold and clammy, and the animal often lies as still as though dead, so complete is the paralysis. Death finally occurs from asphyxia, frequently associated with coma. The respiration ceases before the heart-beat. The urine of poisoned animals may be used as a physiological test in frogs, to decide doubtful cases. The treatment of poisoning consists in evacuation of the stomach and the use of tannic acid, artificial respiration, external

heat, and respiratory and cardiac stimulants, as strychnine, atropine, caffeine and alcohol. The post-mortem appearances are those of asphyxia, with sometimes evidences of gastro-intestinal irritation.

Administration.—Conium is best given in the form of the fluidextract or hydrobromide of the alkaloid. The English use the succus conii, of which the dose for the horse is ʒ ii.-iv.; dog, 3 ss.-i.; but it is inferior to the fluidextract and often inert. The initial dose of any preparation should be small, on account of the variation in strength, but should be rapidly increased until physiological effects are evident.

Uses External.—Conium is occasionally applied externally as a poultice of the leaves, or in ointment (equal parts of cerate and extract of conium), to relieve pain of sores, ulcers, malignant growths, rheumatism and neuralgia. It is thought to be both resolvent and curative on cancers and tumors, but without sufficient basis. It relieves pain when pain is due to spasm.

Uses Internal.—Conium is rarely used in veterinary medicine on account of the uncertainty of its preparations and natural therapeutic limitations. Conium has been employed as a motor depressant in many diseases, but should only be prescribed for spasm due to irritation of nerve trunks or endings; not for spasmodic conditions of central origin. In tetanus and strychnine poisoning, it is valueless, and is not wholly antagonistic (tremors and convulsions) in convulsive disorders. When an animal poisoned with strychnine is given paralytic doses of conium, the tetanic spasms of strychnine still persist. The drug has been prescribed in chorea, however, and with temporary benefit, when the convulsive movements were so severe as to threaten life.

SECTION IV.—DRUGS ACTING ON THE SENSORY NERVES.

Class 1.—Depressing the Sensory Nerves.

COCAINÆ HYDROCHLORIDUM. Cocaine Hydrochloride.*

$C_{17}H_{21}NO_4HCl$. (U. S. & B. P.)

The neutral hydrochloride of an alkaloid obtained from several varieties of Coca, the dried leaves of *Erythroxylon Coca* Lamarck (Fam. *Erythroxylaceæ*), known commercially as Huanuco Coca, or of *E. Truxillense* Rusby, known commercially as Truxillo Coca, yielding not less than 0.5 per cent. of the ether-soluble alkaloids of Coca. Cultivated in Peru and Bolivia and introduced into medicine by Koller in 1884.

Derivation.—Cocaine hydrochloride is recovered by agitating an acidulated alcoholic solution of coca leaves with ether. The ethereal liquid is made alkaline with sodium carbonate and evaporated. The residue is purified, decolorized, neutralized with hydrochloric acid, and finally crystallized.

Description.—Colorless, transparent, monoclinic prisms, flaky, lustrous leaflets or a white crystalline powder; permanent in the air, containing no water of crystallization; odorless; of a saline, slightly bitter taste, and producing on the tongue a tingling sensation followed by numbness of several minutes' duration. Soluble in 0.4 part of water, 2.6 parts of alcohol, and in 18.5 parts of chloroform at 25° C. (77° F.); soluble in benzene, petroleum benzin, and ether. It leaves no residue on incineration. Its aqueous solution is neutral to litmus paper.

Dose.—H., gr.v.-x. (.3-.6); D., gr. ⅛-¾ (.008-.045).

Action External.—Solutions of cocaine (4-10 per cent.), applied to mucous membranes, produce perfect local anesthesia by paralyzing the sensory nerve endings. The functions of the nerves of special sense are abolished before those of ordinary sensibility. Stronger solutions paralyze the motor nerve terminations. The local application of cocaine causes pallor of the mucous membrane, which is succeeded by redness and congestion. The first condition follows constriction of the superficial blood vessels, which is said to be due to tonic contraction of the smooth muscular fibres of the vessel walls.

* These are also official:
Oleatum Cocainæ (5 per cent.) U. S. P.
Unguentum Cocainæ (4 per cent.) B. P.
Injectio Cocainæ Hypodermica (10 per cent.) B. P.

The secondary vascular relaxation, and tendency to congestion in parts subjected to cocaine anesthesia, lessens the resistance of the tissues (especially of sensitive structures, as the eye) to the irritation of antiseptics and bacterial products. Therefore, surgical operations performed under cocaine anæsthesia are somewhat more prone to be followed by inflammation. This only refers to the use of strong solutions.

The Eye.—Cocaine applied locally to the eye stimulates the endings of the sympathetic nerve and dilates the pupil, constricts the blood vessels of the conjunctiva and iris, and causes some exophthalmos and reduction of intraocular tension.

Action Internal.—Digestive Tract.—Cocaine exerts a local anesthetic action upon the gastric mucous membrane, and in this way lessens the appetite and sometimes stops vomiting. Intestinal peristalsis is increased by moderate doses, but is decreased and destroyed by the paralytic action of large doses of cocaine.

Nervous System.—The general action of cocaine on the nervous system may be summed up in descending stimulation followed by depression, beginning with the cerebrum and affecting in order the cerebellum, medulla and spinal cord. Ordinary medicinal doses produce no marked effect upon the nervous system, except some mental exhilaration. Full doses of cocaine stimulate the psychical functions of the brain and cause intoxication, which is followed, in poisoning, by stupor and convulsions. The convulsions are mainly of cerebral origin, but may be due in part to irritation of the spinal reflex centres. These latter centres are first stimulated by toxic doses, but depression and paralysis of the spinal cord follows: the sensory before the motor tract. The sensory nerves are paralyzed and the motor nerves depressed by toxic doses. The voluntary muscles are stimulated by medicinal doses of cocaine and the alkaloid relieves fatigue and, experimentally, more than doubles the response to stimuli in wornout muscles. Voluntary muscles are paralyzed by the local application of large quantities of cocaine. Cocaine is essentially a protoplasm poison when applied, even in dilute solution, directly to animal or vegetable cells, including epithelial cells, leucocytes, spermatozoa, muscle and nerves, and all motion or action of these instantly ceases.

Circulation.—The action of cocaine upon the heart and vessels is not very marked, except in poisoning. The alkaloid is, however, a slight cardiac stimulant in moderate doses, increasing the pulse-rate and tension. The action upon the heart is caused by depression of the cardio-inhibitory centres, and sometimes as well by depression of the cardiac inhibitory ganglia. Vascular tension is increased because of stimulation of the medullary vasomotor cen-

tres, smooth muscle of the vessel walls, and because of the increased action of the heart. On the other hand, both minute and large doses may diminish the pulse rate.

Respiration.—Cocaine is a respiratory stimulant in medicinal doses, but a paralyzant in toxic amounts. The respiratory centres are first stimulated and the breathing is made deeper and quicker. Depression and paralysis of the respiratory centres follow; cyanosis supervenes, and the respirations are shallow and irregular. Death occurs from asphyxia.

Temperature.—The body heat is elevated, sometimes to an excessive degree, by poisonous doses of cocaine. Medicinal doses do not affect the temperature. The rise of temperature is said to follow increased heat production.

Kidneys.—The greater part of the cocaine absorbed is oxidized within the body. The smaller part is eliminated by the kidneys. Experimental evidence concerning the influence of the alkaloid upon the secretion and composition of the urine is conflicting and indefinite. The amount of secretion probably depends upon the state of vascular tension and calibre of the vessels.

The Eye.—Cocaine is used very largely in the eye. It produces local anesthesia, constriction of the blood vessels and dilatation of the pupil with lowering of intraocular tension. The action on the pupil seems to follow stimulation of the terminations of the cervical sympathetic.

Toxicology.—Moderate doses produce in dogs mental exhilaration and joyousness, so that they bark and jump about with delight. Poisoning with large doses (gr. ¼ of cocaine to 2 lbs of live weight) may be divided into three stages. In the first stage, there is restlessness, anxiety and terror, with rhythmical movements. Noises frighten the animal and he fails to recognize his master. The second stage is characterized by a joyous condition, in which dogs bark, dance about and lick people's hands. In the third stage, weakness and nervous phenomena appear,—as muscular twitching, rhythmical movements, a pendulum-like motion of the head, convulsions and stupor. There is dyspnœa, feeble pulse and failing respiration. In an experiment upon a Newfoundland dog, weighing about 100 lbs., conducted by the writer, there were no symptoms produced by 3 grains of cocaine under the skin, except dilation of the pupils and a constant lapping with the tongue. In man, an amount of cocaine exceeding gr. ¾ should not be employed under the skin, or upon mucous membranes, and death has occurred in susceptible patients from even smaller doses. The most powerful action follows the use of cocaine in very vascular parts, as about the face. One-half a grain of cocaine given subcutaneously to a girl of eleven

years old, was followed by a fatal result in 40 seconds, and the writer has seen violent convulsions produced by the instillation of a few drops of a 2 per cent. solution into the eye of a man. On the other hand, spontaneous recovery has obtained in the human subject after the ingestion of 22 grs. of the alkaloid. In the horse, a toxic dose of cocaine (3 i.) causes restlessness and excitement, muscular twitching and trembling, rhythmical movements of head (as nodding and weaving), dilated pupils and salivation, culminating within an hour in a state of acute mania and intense excitement. These symptoms are followed by gradual recovery after the lapse of a few hours. Three grains of cocaine given under the skin, will sometimes induce nervous excitement in susceptible horses. The treatment of dangerous forms of cocaine poisoning, with respiratory and heart failure, consists in the use of opium and rapidly acting stimulants, as morphine sulphate under the skin, nitroglycerin upon the tongue, and strychnine, atropine and brandy subcutaneously. A short inhalation of ether has recently been shown to be a remarkably successful antidote in cocaine poisoning.

Uses External.—Cocaine and its synthetic chemical substitutes are the most valuable agents we possess to cause complete local anesthesia for surgical purposes.* The operations most suitable for the hypodermatic application of cocaine are included in the following.

Removal of tumors.
Docking and pricking the tail.
Tarsal tenotomy.
Firing.
Neurectomy.
Herniotomy.
Operations about the rectum, vagina and uterus.
Examinations and operations about the larynx.
Opening of abscess.
Injuries and operations upon the eyeballs and eyelids.
Operations about the feet in horses.
Operations upon mucous membranes.
Laparotomy in bitches.

The alkaloid may also be employed to dilate the pupil for examination of the eye, and to detect lameness. In a case of doubtful foot lameness in the horse, injection of cocaine into the plantar nerve trunk, on either side of the leg and a little above the point of selection for plantar neurectomy, will often completely abolish sensation in the foot. This fact may be determined by pricking the soft parts above the hoof. If there is complete anesthesia of the foot, and the seat of lameness be situated therein, the horse will

* Cocaine in surgery can often be combined most advantageously with adrenalin.

go sound while the anesthesia lasts. This method may be taken advantage of in the diagnosis of localized lameness elsewhere. If cocaine is injected over an area (suspected to be the cause of lameness), and the animal goes sound while the cocaine anesthesia lasts, the site of lameness becomes certain.

It has been discovered that injections of powerful cocaine solutions into a sensory nerve trunk will paralyze its sensibility throughout the peripheral distribution (regional anæsthesia). When ligation of a limb, or part, can be secured between the operative field and the heart, the anæsthetic action of cocaine is more profound and toxic symptoms are less liable to occur, since the drug is drained away in the blood during the operation. Many operations can be performed under cocaine, as neurectomy, firing, tenotomy, etc., without casting the horse. In using cocaine for the removal of tumors, or opening of abscess, the solution is injected at several points in a circle about the base of the tumor or abscess, and not in the inflamed tissue of the latter. Following the first injection, the succeeding applications may be made painless by inserting the needle within the area made anæsthetic by the previous injection (circumferential anæsthesia).

The amount of cocaine solution to be injected is of importance. This depends upon the strength of the solution, the weight and species of the animal, and the seat of application. A solution stronger than 4 per cent. is irritating to the eye. The stronger cocaine solutions (5 to 10 per cent.) are more powerful paralyzants to the sensory nerves, and are advisable when they can be used with safety, but a 4 or 2 per cent., or even a much weaker solution, will ordinarily produce anesthesia when introduced under the skin. In the horse, subcutaneous injection of a 5 or 10 per cent. solution may be made to the amount of 2 drachms of the former, or 1 drachm of the latter solution (cocaine, gr. 6). Larger doses may induce restlessness, excitement, etc., which, although not indicative of danger, may interfere with operative procedures. When larger quantities are desirable, 2½ drachms of a 4 per cent. solution, or 5 drachms of a 2 per cent. solution, may be employed (equivalent to 6 grs. of the alkaloid), or Schleich's solution may be utilized. Not more than 7 to 15 drops of a 10 per cent. solution should be injected into dogs. This is equivalent to gr. ¾ and gr. 1½ of the alkaloid. Three-quarters of a grain of cocaine is a safe limit of dosage for small dogs. If a 2 or 4 per cent. solution is employed, 30 M. of the former, or 15 M. of the latter solution (equivalent to gr. ⅗ of cocaine) may be injected. When larger amounts of the anesthetic solution are indicated for dogs, Schleich's method of infiltration is appropriate (infiltration anesthesia).

This method depends upon the fact that the pressure of saline solutions injected into the tissues causes a benumbing of the sensory nerves, and also upon the anæsthetic action of minute doses of cocaine and morphine. Schleich's solution may be used in any amount and can be made conveniently from the tablets prepared by chemists. The ordinary solution contains:

1 part of cocaine hydrochloride.
2 parts of common salt.
0.1 part of morphine hydrochloride.
In 1,000 parts of sterile water.

NOTE.—Since writing the above, it has been found that the morphine in Schleich's solution is an irritant rather than a local anesthetic, and when large quantities of cocaine or eucaine are to be used under the skin—or danger is, for any reason, to be anticipated—the writer would strongly advise the employment of a normal salt solution (4 grains sodium chloride to 1 drachm of water), containing from ½ to 1 p. c. of cocaine (or eucaine, 1 p. c.). These weaker solutions will usually cause complete and safe local anæsthesia. The solutions should always be warm—at body temperature—and not over twenty-four hours old, as acid develops which interferes with the anesthetic action. They are most conveniently made by solution of cocaine tablets in salt solution at the time of operation.

Ritter has secured most satisfactory general anesthesia in dogs by injecting intravenously 10 c.c. of a 1 per cent. solution of cocaine for small animals; and 5 c.c. of a 3 to 5 per cent. solution in normal salt solution for large dogs. The anesthesia came on in 2 to 5 minutes and lasted 15 to 30 or more minutes. Moreover there were no untoward results and operations on any part of the body could be painlessly done without any struggling on the part of the patient.

Both eucaine and cocaine have been used recently with success for work on a limb by injection into a vein between the site of operation and body. A tourniquet is first applied about the limb proximally to the point of injection.

Local applications to mucous membranes may be reapplied, once or twice, at intervals of five minutes, to secure perfect anesthesia. A larger quantity of cocaine than recommended above for hypodermatic use, should not be employed. Cocaine, as already stated, produces a primary astringent action, followed by secondary irritation and vascular relaxation; yet, when properly diluted and applied in the first stage of inflammation, it may prove a valuable abortive and sedative agent.

Hemorrhage from mucous membranes can be arrested by its topical application; coryza aborted, and hemorrhoids relieved by this method. Pruritus, about the anus and vagina, is allayed by cocaine. In relation to the eye, 5 to 10 drops (horse) of cocaine solution (1 to 4 per cent.) are employed for various purposes, embracing ex-

amination, removal of foreign bodies, operations, and the relief of suffering in acute inflammation resulting from natural causes or mechanical irritation. The following prescription is of value in superficial inflammatory and painful conditions of the eye:

℞

Cocainæ hydrochlor..... gr.v.
Acid. borici..... gr.x.
Aq. dest. ad..... ʒ i.

M.

S. Instil a few drops into the eye hourly.

Injection into the eyeball is preferable to instillation for enucleation.

Solutions of cocaine should be freshly made, and must not be sterilized by boiling, although they should be made with sterile water, or, better, normal salt solution. The tablets supplied by pharmaceutical chemists are convenient for hypodermatic use. Ten grains of boric acid will preserve an ounce of cocaine solution for a month.

Spinal anesthesia has come into use within the past few years in both human and veterinary practice. Leonard Corning was the pioneer having shown in 1885 that cocaine injected between the 11th and 12th dorsal spines caused analgesia of the lower limbs in man. The point of injection in animals is in the lumbo-sacral space. This is found by drawing a line connecting the spines of the lumbar and sacral vertebræ and another at right angles connecting the summits of the internal angles of the ilium.

Directly at the point of intersection of these lines is the place for puncture in the dog and cat, and about ¾ of an inch forward of this point is the site for puncture in the horse. The hair must be clipped and shaved from the dry skin and the site well swabbed with tincture of iodine and as soon as dry the puncture may be made with a boiled needle or trochar and canula.

The smaller animals should be on their side with back arched. The needle or trochar is thrust in perpendicularly till the resistance lessens and cerebro-spinal fluid drops from the needle. This proves entrance into the spinal canal. No more fluid should be lost than is to be replaced by the injection. Sepsis means death, so that the necessity of asepsis will be fully appreciated. Anesthesia affects chiefly the posterior portion of the body and hind limbs but the fore limbs are also partly anesthetic. This action begins in 2 to 10 minutes, is fully developed in 20 to 30 minutes, and lasts from 1 to 5 hours. While never generally accepted as a substitute in human surgery for ether, and while perhaps its use is diminishing, yet there is more reason for its employment in veterinary surgery on account

of the expense of general anesthesia. The mortality from it has been about 3 per thousand in human surgery.

In addition the following undesirable results have been occasionally seen: Sepsis and meningitis, 4 to 14 per cent. of failures to secure good anesthesia, collapse, retention of urine, chills, fever, vomiting, sweating, persistent paraplegia, pain in back and legs for months, nausea, cramps in the limbs, incontinence of urine, etc.

Cocaine or its substitutes must be sterile for spinal anesthesia. As cocaine can not be boiled it may be dissolved in ether and when the ether has evaporated sterile water is added. A 2 per cent. solution of cocaine is commonly employed. Of this the dose is as follows: H., m.xx. to xlv. Dog and cat, m.v. to x.v. The puncture may be made with the syringe attached to the needle for a handle. Then detach the syringe. After the spinal fluid drips from the needle which has entered the dura the syringe, already filled with the cocaine solution should be again attached to the needle and the proper amount injected. On removing the needle the puncture should be closed by collodion and cotton.

Rudolf Klapp (Deutsche Zeitschr. f. Chir. 1904, Vol. lxxi, p. 187) has experimented upon animals with spinal injections for the production of anesthesia, and finds by combining gelatin, adrenalin and cocaine, the toxic effect of the latter is wholly averted and that this combination is a safe and perfect anæsthetic for dogs. Five cc. of a sterilized 10 per cent. aqueous gelatin solution, containing 10 m. of adrenalin (1-1000 solution) and 0.02 to 0.04 gm. of cocaine, are then injected through the trocar and the puncture sealed with iodoform collodion.

The following operations have been performed painlessly under spinal anæsthesia in the lower animals: Neurotomy, tenotomy, cauterization, oöphorectomy, castration, operations on the uterus and rectum, urethrotomy, herniotomy, etc. Wherever local anesthesia is available spinal anæsthesia should not be used on account of its much greater dangers but its field of usefulness is wider than in human surgery.

Uses Internal.—Cocaine may be administered in aqueous solutions for the relief of persistent vomiting in dogs. The alkaloid is occasionally used as a stimulating and supporting agent in asthenic fevers and adynamic conditions of the human patient. The subcutaneous injection of cocaine (gr. iii.) is of great value in heat prostration of horses.

Novocaine, $NH_2\ C_6H_4\ COC_2\ H_4N\ (C_2H_5)_2$, occurs in colorless crystals very soluble in water. It is the latest and apparently the best substitute for cocaine as it is equal to cocaine as a local anesthetic

and is said to be 5 times less toxic and much less irritating to the tissues—less, indeed, than either eucaine or stovaine.

One to two per cent. solutions are suitable for subcutaneous use. Dropped into the eye in 5 to 10 per cent. solutions it will anesthetize the eye so that operations may be done on the eyeball or lid. Two or three drams of a 3 per cent. solution injected into the nerve on either side of the limb are sufficient in the diagnosis of lameness in the horse. Its action is increased by combination with adrenalin and with the added hemostatic action this combination is useful injected about the circumference of tumors to aid their painless removal. Solutions keep well and may be repeatedly boiled.

Eucainæ Hydrochloras. Eucain Hydrochlorate.
$C_{19}H_{27}NO_4HCl$. (Non-official.)

This is a laboratory product, formerly known as eucain hydrochlorate "B." Eucain is used in 2 per cent. aqueous solution in the eye, and in 10 per cent. on mucous membranes, and is said to be harmless in any ordinary amount. It is employed as a substitute for cocaine in the same manner and for the same purposes, but with the following advantages: Safer, 3 times(?) less toxic; cheaper; does not decompose on keeping in solution; can be sterilized by boiling; less irritating; does not dilate the pupil; is a slight antiseptic.

Ophthalmologists find that the drug does dilate the pupil after several instillations, and that it does irritate the already inflamed eye. It, moreover, does not contract vessels when locally applied, and does sometimes produce poisoning like cocaine, but much less frequently.

Stovaine. ($C_{14}H_{21}NO_2HCl$).

Occurs in small, lustrous scales, very soluble in water, acetic ether and alcohol. It is a synthetic product used as a substitute for cocaine but is only ½ as toxic; slower to induce anæsthesia (15 to 30 minutes); and the anæsthesia is of longer duration (2 hours). Solutions may be boiled without harm to the drug.

It produces some vasomotor relaxation, but solutions may be combined with ♏x. of adrenalin solution to avert this. 3 to 5 grs. in 6 drams of sterile water may be used safely and successfully in spaying bitches of setter size (gr. ii. for fox terriers). Two and one-half drams are injected intraperitoneally in the region of the internal inguinal rings, on each side, and 1 dram into the skin in-

cision. After keeping the animal on its back for 20 or 30 minutes the operation is begun (Eggleston and Miller).

Cocaine (gr. ½-¾) injected into the muscle of the abdominal wall in dogs, along the line of incision, will induce anesthesia of the abdominal organs to a considerable degree.

Stovaine is used in 5 per cent. solution to produce anæsthesia by intraspinal injection. The dose of this solution for this purpose is for horses, 3 i-iiss; D. m., xx-xxx; cats, m. x-xx. For excision of the eyeball in the horse one dram of a 5 per cent. solution is injected under the conjunctiva at four or five points. In the dog one dram of a 2 per cent. solution is sufficient for this operation. For subcutaneous use 1 to 2 per cent. solutions are suitable.

Alypine is another substitute for cocaine and is closely related in composition with stovaine. It is not, however, superior to cocaine since it is both more toxic and irritant.

Yohimbine Hydrochloride. $C_{22}H_{28}N_2O_3HCl$.

Yohimbine is obtained from the bark of the yohimbehe tree (Corynanthe yohimbi), and occurs in silky, prismatic crystals, or as an amorphous, white powder, slightly soluble in water, soluble in alcohol, ether, chloroform and acids. Yohimbine alters and turns yellow on exposure to air and light, but its hydrochloride is permanent and is therefore to be preferred.

Dose.—H. & C., gr. ¾-1½ (gm. .045-.01); Sh. & Sw., gr. ½ (gm. .03); D., gr. ½₀-⅙ (gm. .005-.01); small dogs, gr. $^1/_{120}$ (gm. .0005).

Tablets are sold under the name of vetol for use in veterinary practice. The stronger tablets contain 0.1, or gr. 1½ of yohimbine hydrochloride, are colored red and are suitable for the larger animals. The weaker tablets are gray and contain 0.01, or gr. ⅙ of yohimbine and are suitable for sheep and swine, or divided, for dogs. Treatment should be begun with the smaller doses thrice daily and gradually increased to the larger if no effect is observed from the smaller doses. The drug is given with food or drinking water, or in tablet form.

Action.—External.—Yohimbine, in 1 to 2 per cent. solution, has a decided local anesthetic action similar to that of cocaine on the nerve trunks and terminations. Unlike cocaine it does not contract vessels nor cause mydriasis in the eye. It also resembles cocaine in its toxic action on the central nervous system.

Action.—Internal.—Circulation.—Yohimbine occupies rather a unique position in medicine. Its peculiar therapeutic action consists

in stimulation of the sexual organs. Cantharides, used for this purpose, is a powerful irritant to the urinary tract which is not the case with yohimbine.

Strychnine, phosphorus, and alcohol stimulate the spinal sexual centres but are uncertain aphrodisiacs. Yohimbine has a specific action in causing local dilatation of the vessels of the testicles, ovaries, penis and vulva so that swelling and congestion of these parts occur.

The testicles of rabbits, under its influence, become many times their natural size and the external genitals of the larger female animals may be seen to become swollen. Moreover, the lumbar spinal centres concerned with erection and the sexual act are directly excited by the drug. The sexual reflexes are made more acute for this reason and because of the increased irritability of the external genitals.

In the male frequent and prolonged erections appear and sexual excitement is marked in both males and females following its ingestion.

The author has noted ovarian pain in women taking the drug which may be attributed to swelling of the ovaries. The vascular dilatation is due to direct action of yohimbine on the vessel walls. The cutaneous vessels also dilate, the ears become warmer and redder and the combs in fowl become more brilliant. Vascular dilatation of the internal organs is said to occur also, with marked lowering of blood pressure.

The heart is not affected by ordinary doses.

Nervous System.—Large doses stimulate the central nervous system so that mental excitement and exhilaration (in man), and restlessness ensue.

Respiration.—Even medicinal doses stimulate the respiratory centre and the movements become deeper and more rapid.

Mammary Gland.—The action on this gland is similar to that on other parts of the sexual apparatus and congestion and increased milk secretion are observed.

Toxicology.—Large doses induce restlessness and excitement, rapid pulse and respiration, with fall in blood pressure. Toxic amounts cause convulsions and paresis, diarrhea, salivation, dyspnea and heart weakness. One-half a grain is said to have proved fatal to a dog.

Uses.—Yohimbine is indicated in functional impotency in the male due either to lack of sexual desire or to lack of sexual power. Impotency may be symptomatic as of sexual excess, irritability, chronic prostatitis or vesiculitis, malnutrition, anemia, overwork and obesity. But in apparently healthy animals where no removable

cause can be discovered yohimbine offers most hope of a cure. It stimulates sexual desire by exciting the centres and peripheral reflexes, and sexual power in the male by causing erections.

In the female also lack of sexual desire and absence of oestrum may be corrected by the drug.

Yohimbine appears to be more successful in veterinary than in human practice where the failures in the treatment of impotency are more frequent than the successes. In impotent bulls, stallions, rams, boars and dogs, and in barren and frigid mares, cows, ewes, sows and bitches the drug often acts favorably.

Its use has been extended to other conditions. Thus it is reported to have been successful in the treatment of chronic metritis by occasioning active uterine hyperemia. As a nerve stimulant it has been employed with supposed favorable results in bovine parturient paraplegia and in paraplegias of dogs. The drug is rather expensive at present.

SECTION V.—DRUGS ACTING ON THE SECRETORY NERVES.

Class 1.—Pilocarpus and Pilocarpine.

PILOCARPUS. Pilocarpus. (U. S. P.)

Synonym.—Jaborandi, B. P.; the leaflets of Pilocarpus Jaborandi Holmes, or of Pilocarpus microphyllus Stapf. (Fam. *Rutaceæ*), yielding not less than 0.5 per cent. of alkaloids.

Habitat.—Brazil, in the neighborhood of Pernambuco.

Description.—Pilocarpus Jaborandi.—Very shortly and stoutly petioluled, the blades 6 to 12 Cm. long and 2 to 4 Cm. broad, oblong or oval, mostly unequal at the base, blunt and emarginate at the summit, the margin entire and narrowly revolute; yellowish-green, very smooth, shining, thick and coriaceous, the reticulate venation prominent on both sides, especially beneath; strongly pellucid-glandular; peculiarly aromatic when crushed; taste bitterish, slightly salty, aromatic, later somewhat pungent and sialagogue.

Pilocarpus microphyllus.—Leaflets 1.2 to 3.7 Cm. long, 0.8 to 1.6 Cm. broad; the lateral without petiolules, rhomboidally oval to obovate, acute at the base, blunt and unequally emarginate at the summit; the terminal on short, margined petiolules, almost equally

oval to obovate, rather narrower than the lateral; all thickish and rigid, with entire margin, smooth and dull green, finely pellucid-glandular; midrib stout, the veins rather coarsely reticulate, lightly prominent; almost odorless; taste similar to that of *Pilocarpus Jaborandi.*

Constituents.—1. Pilocarpine, $C_{11}H_{16}N_2O_2$ (.25-.5 per cent.) is the alkaloid to which jaborandi owes its principal effect. 2. Jaborine, $C_{22}H_{32}N_4O_4$, an alkaloid resembling atropine in its action on the heart, pupils, intestines and salivary glands. It occurs occasionally as an impurity in commercial pilocarpine, to which it is antagonistic. It is soluble in alcohol. (Recent investigators deny the action or even existence of such a substance in pilocarpus.) 3. Pilocarpidine ($C_{10}H_{14}N_2O_2$), an alkaloidal product of the decomposition of pilocarpine, which is inert. It is soluble in alcohol. 4. A peculiar acid. 5. A volatile oil, chiefly pilocarpene, $C_{10}H_{16}$.

Dose.—H. & C., 3 ii.-iv. (8.-15.); Sh. & Sw., 3 ss.-i. (2.-4.); D., gr.v.-3 i. (.3-4.).

PREPARATIONS.

Fluidextractum Pilocarpi. Fluidextract of Pilocarpus. (U. S. P.)

Made by maceration and percolation with diluted alcohol, and evaporation. Standardized so that each 100 cc. of the fluidextract contains 0.4 gm. of the alkaloids from pilocarpus.

Dose.—H. & C., 3-ii.-iv. (8.-15.); Sh. & Sw., 3 ss.-i. (2.-4.); D., ɱv.-3 i. (.4-4.).

Extractum Jaborandi Liquidum. (B. P.)

Dose same as above for fluidextract.

Pilocarpinæ Hydrochloridum. Pilocarpine Hydrochloride. $C_{11}H_{16}N_2O_2HCl$. (U. S. P.)

Derivation.—The hydrochloride of an alkaloid obtained from pilocarpus, with alcohol and hydrochloric acid, by distillation and evaporation. The residue is dissolved in a slight excess of ammonia and chloroform, shaken with water, and neutralized with hydrochloric acid. Crystals of the hydrochloride form on evaporation. The salt is purified by recrystallization.

Properties.—Small, colorless or white transparent crystals, odorless and having faintly bitter taste; deliquescent on exposure to damp air. Soluble in 0.3 part of water and in 2.3 parts of alcohol; almost insoluble in ether or in chloroform.

Dose.—H., sialogogue, gr.i.-ii. (.06-.12); cathartic, gr.ii.-v.

(.12-.3); C., cathartic, gr.v.-x. (.3-.6); H., diaphoretic, gr.vi.-xii. (.36-.72), dangerous; Sh., gr.i. (.06); D., gr. $\frac{1}{10}$-$\frac{1}{3}$ (.006-.02).

PILOCARPINÆ NITRAS. Pilocarpine Nitrate. (U. S. & B. P.)

Colorless, or white, transparent, odorless, faintly bitter-tasting crystals, soluble in four parts of water and in 16 parts of alcohol. Permanent in the air.

Dose.—Same as for hydrochloride.

ACTION OF PILOCARPUS AND PILOCARPINE.

Internal.—Alimentary Canal.—Pilocarpine increases enormously salivary secretion, and, in a less degree, the gastric and intestinal secretions. It stimulates peristaltic action of the stomach and bowels as well, and acts as a purgative. Salivation is due to direct excitation of the secretory nerve (chorda tympani) endings in the gland cells. Salivation occurs when pilocarpine is injected into the gland and prevented from entering the general circulation; also when the secretory nerves are severed. The action on the salivary glands is set aside by atropine. The parotid, submaxillary, and sublingual glands become somewhat tense and tender under the influence of pilocarpine, and the saliva is rich in salts and ptyaline, and contains a slight excess of urea. The unstriped muscle of the stomach and intestines is stimulated by pilocarpine through its action on the efferent nerve endings and muscular tissue.

Circulation.—Pilocarpine increases leucocyte formation in the blood. In the lower animals the alkaloid stimulates the vagus endings in the heart. The action is succeeded by depression of the vagus terminations and, after large doses, by depression of the heart muscles and vagus centres.

The pulse is then at first slow, next it becomes accelerated, and finally slow and weak with loss of tension.

In man, and occasionally in dogs, the pulse is often at the beginning frequent and the vascular tension is increased. The physiological reasons for this are unknown.

Respiration.—The respiration is not directly affected by the drug, in moderate doses, but the bronchial secretions are greatly increased, the bronchioles are much constricted, and in poisoning there are, in consequence, edema of the lungs and dyspnea. Weakness of the circulation and contraction of the bronchial muscles account for the edema. There is also great excess of secretion which may aggravate the drowning process. The respiration becomes weak and slow and death occurs from asphyxia after lethal doses.

Nervous System and Muscles.—Medicinal doses do not cause any functional disturbance of the nervous system, but very large doses excite the spinal motor tract and reflex centres and cause convulsions in frogs, succeeded by spinal depression and paralysis. The latter is due in part to an influence on the muscles themselves. Tremors occur occasionally in man and the domestic animals in poisoning. The nerves escape unscathed. The involuntary muscles are stimulated throughout the body, owing to the direct action of the drug upon their motor nerve terminations.

Skin.—Moderate doses of pilocarpine stimulate but slightly the secretion of sweat in the lower animals, but in man the secretion is enormous (1 pt.). The salivary secretion appears to supplant that of the skin in the domestic animals, unless very large doses are employed (H., gr.vii.-xii.), which cause diarrhea, salivation and loss of body weight (40 to 60 lbs.), and may entail pulmonary edema and heart failure. The secretory nerve terminations are stimulated. The secretion of tears, nasal mucus and milk are slightly increased in the same manner, and the growth of hair is rendered more luxurious.

Temperature.—The temperature is reduced by evaporation from the skin, if there is much sweating.

Genito-Urinary Organs.—Pilocarpine exerts a slight and uncertain oxytocic action on the pregnant uterus and has sometimes precipitated parturition in pregnant animals at full term. The unstriped muscle of the spleen and bladder is stimulated, and micturition is frequent. Pilocarpine, in repeated small doses, augments the flow of urine and probably increases tissue waste and the excretion of urea by its general action on the secretions. It is eliminated unchanged by the urine.

Eye.—Pilocarpine contracts the pupil when applied to the eye; it also reduces tension of the eyeball and induces contraction of the ciliary muscle. The myosis is due to stimulation of the peripheral oculomotor nerve endings. When the alkaloid is given internally it may contract the pupil, but jaborandi, or the fluid extract, are less likely to do so on account of the opposing alkaloid (jaborine), which tends to dilate the pupil.

Summary.—Pilocarpine possesses two important actions. 1. To increase secretions (stomach, pancreas, intestines, salivary glands, sudoriparous, lachrymal and mammary glands, kidneys, bronchial and nasal mucous membranes, and ear). 2. To stimulate the involuntary muscles (stomach, intestines, heart, bronchial tubes, uterus, bladder, spleen, vessels and iris). Both actions are peripheral and are exerted on the secretory and motor nerve terminations.

Administration.—Pilocarpine is given usually when an immediate effect is desired. Therefore the hydrochloride or nitrate are employed subcutaneously. If prescribed in combination with eserine, the sulphate of both alkaloids may be used, or eserine sulphate and pilocarpine hydrochloride may be injected separately.

Toxicology.—Symptoms appear in five or ten minutes after the subcutaneous injection of pilocarpine, and in fifteen to twenty minutes after the injection of jaborandi. Salivation alone occurs after small doses, but with toxic quantities there are present salivation, accompanied by more or less sweating, intestinal colic, purging and perhaps vomiting, a slow, weak pulse, and dyspnea. Muscular tremors are observed sometimes in man, and convulsions in frogs, but spasmodic movements are uncommon in the domestic animals. Dogs have been killed by gr. ¾ of pilocarpine. The administration of an amount larger than 5 grs. of the alkaloid to horses, subcutaneously, is attended with danger. Cattle withstand as much as 18 grains of pilocarpine subcutaneously without a fatal result. Atropine is the physiological antagonist of pilocarpine in relation to the heart, secretions, pupils, and, in large doses, probably to the intestines. On the other hand pilocarpine is not nearly so efficient an antidote to atropine as atropine is to pilocarpine. Enormous amounts of pilocarpine are required to antagonize small doses of atropine.

So that it has not proven very useful in atropine poisoning and as an antidote an amount should be given at least 4 times that of the atropine taken.

Atropine should be given along with strychnine and alcoholic stimulants, or ammonia, in jaborandi or pilocarpine poisoning.

Uses External.—The fluidextract of pilocarpus, 1 part; is often used with tincture of cantharides, ½ part; and alcohol, 2 parts, for the cure of alopecia.

Uses Internal.—The chief value of pilocarpine in veterinary medicine consists in its use as a purgative to stimulate peristaltic action, and, to a certain extent, secretion—in combination with physostigmine—in obstinate constipation of horses, and in impaction of the rumen and omasum, and in acute gastritis of cattle (pilocarpine, gr.-iii., with eserine sulphate gr.-i., subcutaneously). It is also given in colic, and in obstructions from twist and intussusception, with physostigmine. Pilocarpine has been recommended in pneumonia and bronchitis as an expectorant but its tendency to pulmonary edema and heart weakness would contraindicate its use in these disorders. The alkaloid is a good substitute for eserine for application to the eye (in 1 or 2 per cent. solution), and is less painful. Pilocarpine is theoretically an antidote to atropine, and should be administered in amount equal to 4 times that of atropine. Jaborandi

is employed to remove waste matters from the blood and system (in nephritis and effusions), but is of little value in veterinary practice, compared with its efficiency in human medicine, on account of its feeble sudorific action. It has been recommended (gr. $\frac{1}{12}$-$\frac{1}{6}$, subcut.) in dropsy of cardiac origin, not uncommon in dogs, but is dangerous, since it tends to produce pulmonary edema and heart weakness. For the same reason it is inadvisable in pleuritic effusions and renal dropsy, and in all three conditions it is inferior to purgatives and diuretics stimulating to the heart, as caffeine and theobromine, and paracentesis. Pilocarpine is highly recommended by the Germans in cerebral and spinal meningitis, to assist absorption of effusion. Pilocarpine stimulates the skin in its elimination, and is sometimes of service in chronic eczema, psoriasis, prurigo, and chronic urticaria. Pilocarpine in alcohol (gr. i. to ʒ iv.) applied externally, is the most popular remedy to stimulate the growth of air in alopecia. Or half an ounce each of fluidextract of pilocarpus and tincture of cantharides may be used with an ounce each of glycerin and liquid vaseline. It is recommended in chronic rheumatism as an eliminative, and in acute inflammation of the brain, and it may be employed to stimulate the gland in chronic idiopathic parotitis. Small doses of pilocarpine have been employed successfully to stimulate a failing milk secretion, and to prevent excessive sweating in general debility. Jaborandi relieves dry throat and excessive thirst. Obesity, in robust dogs, may be treated with pilocarpine under the skin, in one-half grain doses daily. Success sometimes attends this method. The drug is contraindicated when there is impairment of the respiratory functions, a weak or fatty heart, and in unconsciousness, when excessive secretion may obstruct the air passages.

SECTION VI.—DRUGS ACTING ON THE HEART.

Class 1.—Increasing the Force and Decreasing the Frequency of the Heart.

Digitalis. Digitalis.

Synonym.—Digitalis folia, B. P.; foxglove, digitalis leaves, E.; digitale, feuilles de digitale pourprée (de grande digitale), Fr.; fingerhutkraut, G.

The dried leaves of *Digitalis purpurea* Linné (Fam. *Scrophulariaceæ*), collected from plants of the second year's growth, at the commencement of flowering.

Description.—Usually in more or less crumpled and broken fragments; ovate to oval, from 10 to 30 Cm. long, 5 to 15 Cm. broad, abruptly contracted into a winged petiole from 5 to 10 Cm. long; thin, dull and rather pale green or grayish underneath; upper surface wrinkled, sparsely hairy; lower surface densely and finely hairy, the venation conspicuously reticulated; margin crenate or erose-dentate; the midrib and principal veins broad and flat, usually purplish, the lower veins continued into the wings of the petiole; odor slight, characteristic; taste strongly bitter.

In the powder, stone-cells, star-shaped hairs, and calcium oxalate crystals are absent.

Constituents.—The active principles of digitalis are four glucosides; the three first represent its stimulant action. 1. Digitoxin, the most poisonous and active. Said to be cumulative. It occurs in crystals, soluble in alcohol, and chloroform, slightly in ether, and insoluble in water.

Dose.—Gr., ⅛-¼ (.008-.015); D., gr. $\frac{1}{250}$-$\frac{1}{50}$ (.00025-.00125).

2. Digitalein, an amorphous, bitter substance, soluble in water and alcohol and non-cumulative.

Dose.—H., gr. ⅛-¼ (.008-.015); D., gr. $\frac{1}{100}$ (.0006).

3. Digitalin, a bitter, crystalline body, soluble in alcohol, and sparingly soluble in water and ether.

Dose.—H., gr. ⅛-¼ (.008-.015); D., gr. $\frac{1}{200}$-$\frac{1}{100}$ (.0003-.0006).

4. Digitonin * ($C_{27}H_{44}O_{13}$), resembling, or identical with,

* There exists another glucoside in digitalis—digitophyllin—which has been insufficiently studied.

saponin of senega. Soluble in water. It is a heart depressant, muscular paralyzant and powerful irritant, besides being antagonistic to digitalis. In addition to these principles, there are: 5. Digitin, an inert body. 6. Digitalic and antirrhinic acids. 7. Tannin, coloring matters, starch, sugar, gum, a volatile oil, salts, etc., common to most vegetables.

Five substances are found in commerce: 1. Nativelle's digitalin ($C_{25}H_{40}O_{15}$), occurring in white crystalline tufts composed of needles. It is bitter, and soluble in alcohol and chloroform; insoluble in water or ether. It contains digitoxin, digitalin, digitalein and digitonin, but mainly digitoxin, and is cumulative.

Dose.—H. & C., gr. ¼-½ (.015-.03); D., gr. 1/60-1/30 (.001-.002).

2. Homolle's or Quévenne's digitalin, an amorphous, whitish powder, or small scales; very bitter, inodorous, and soluble in alcohol and in 2,000 parts of water. It is composed largely of digitalin, with a little digitoxin.

Dose.—H. & C., gr. ¼ (.015) = gr. 22½ of digitalis leaves; D., gr. 1/60-1/30 (.001-.002) = gr. 1½-3 of digitalis leaves.

3. German Digitalinum Purum, consisting chiefly of digitalein with some digitalin and digitonin.

Dose.—H., gr. ss.-i. (.03-.06); D., gr. 1/60-1/30 (.001-.002).

Neither Nativelle's nor Homolle's digitalin form a complete substitute for digitalis, and their use is not recommended. Schmiedeberg's digitalin* is, however, said to be the best substitute, by eminent authority.

4. Digitoxin, see above for doses. 5. Digitalin, see above for doses.

Incompatibility.—Digitalis is incompatible with tannic acid, lead acetate, cinchona and ferric salts.

Digitalis Folia Dose.—H., gr.x.-3 i. (.6-.4); C., 3 ss.-i.ss. (2.-6.); Sh. & Sw., gr.v.-xv. (.3-1.); D., gr.ss.-iii. (.03-.2).

PREPARATIONS.

Extractum Digitalis. Extract of Digitalis. (U. S. P.)

Made by maceration and percolation with alcohol and water; distillation of the alcohol and evaporation to pilular consistence.

Dose.—H. & C., gr.v.-xx. (.3-1.3); D., gr.¼-1. (.008-.06).

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* This preparation is the Digitalin "German" of Merck, and may be given in the same doses as Homolle's digitalin. No one glucoside of digitalis represents the action of the whole drug, as obtained by use of the tincture or fluid extract.

Fluidextractum Digitalis. Fluidextract of Digitalis. (U. S. P.)

Made by maceration and percolation with alcohol and water, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—H., ♏x.-3 i. (.6-4.); C., 3 ss.-i.ss. (2.-6.); Sh. & Sw., ♏v.-xv. (.3-1.); D., ♏ss.-iii. (.03-.2).

Tinctura Digitalis. Tincture of Digitalis. (U. S. & B. P.)

Made by maceration and percolation of powdered digitalis (100), with sufficient alcohol and water to make 1,000. (U. S. P.)

Dose.—H. & C., 3 ii.-vi. (8.-24.); Sh. & Sw., ♏xxx.-3 i.ss. (2.-6.); D., ♏v.-xxx. (.3-2.).

Infusum Digitalis. Infusion of Digitalis. (U. S. & B. P.)

Digitalis, 15; alcohol, 100; cinnamon water, 150; boiling water, 500; cold water to make 1,000. By maceration. (U. S. P.)

Dose.—H. & C., ℥ ii.-vi. (60.-180.); Sh. & Sw., ℥ ss.-i. (15.-30.); D., 3 i.-iv. (4.-15.)*

Digitalone is a watery, fluidextract corresponding in strength to the tincture (10 per cent. of crude drug) preserved by admixture with chloretone (0.6 per cent.) and representing all the active principles of digitalis. It is moreover standardized by physiological tests and is sterile.

The preparation is now probably the best for internal or subcutaneous use in the same doses as the tincture.

It is excellent, therefore, to use under the skin in emergencies as in heart failure from disease, after operations, and in shock and poisoning. The action of digitalis being slow such drugs as alcohol, ammonia and camphor should first be resorted to in these conditions.

ACTION OF DIGITALIS.

External.—None.

Internal.—*Alimentary Canal.*—Digitalis in large doses is a gastro-intestinal irritant, and in poisoning causes nausea, colic, purging, and vomiting in animals capable of the act.

Circulation.—The dominant action of digitalis is expended upon the heart and blood vessels. After medicinal doses we find the pulse becomes: 1. Slower. 2. Fuller and stronger. 3. More regular in rhythm, if previously irregular. In poisoning, these phenomena are reversed and the pulse is: 1. Rapid. 2. Weak. 3. Irregular. The therapeutic effects following moderate doses are due to: 1. Stimulation of the heart muscle, and perhaps its contained ganglia

* The infusion contains chiefly digitonin and digitalein, on account of their solubility in water, and therefore is lacking in the most stimulating principles.

(pulse stronger and somewhat less frequent). 2. Excitation of the vagus centre and the vagus cardiac terminations (pulse infrequent). 3. Stimulation of the muscular walls of the vessels and vasomotor centres (increased vascular tension). The tension is also augmented by the greater force of the heart beat, and, on the other hand, the heart is slowed in overcoming the increased resistance in the vessels. In consequence of the action on the heart the ventricular contractions are complete and forcible (stimulation of the heart muscle); and the diastolic period is lengthened (increased dilatation of the ventricle owing to vagus stimulation); therefore, more blood enters the viscus and more is squeezed out with each contraction. In poisoning, the symptoms noted above follow: 1. Excessive irritability of the heart muscle (pulse rapid). 2. Insufficient filling of the vessels and paralysis of the vessel walls (low tension). 3. Irregularities of rhythm occur (pulse irregular). There may be several systoles with scarcely any diastolic periods; the heart may beat slowly and weakly at one time, and rapidly and strongly at another. All sorts of indescribable irregularities in rhythm may be seen. At one time the heart beats slowly and weakly; at another time the heart beats rapidly and strongly. The heart, during this irregular toxic period, is seen to be unequally affected, in that one portion (the apex) may be firmly contracted while the rest of the ventricle is dilated. Moreover, the auricles and ventricles do not act synchronously, owing to inhibition of impulses from auricle to ventricle. The irregularities and rapidity of rhythm increase more and more (delirium cordis), until both auricles and ventricles lapse into fibrillary contractions, and death in mammals occurs in diastolic arrest with dilatation to the extreme limit. It has been taught, that this arrhythmia and rapidity of the heart's action is due to the fact that the excited vagi are fighting with the stimulated muscular contractions for supremacy. That forcible contractions are contending against prolonged dilatation of the ventricles. Recent work shows, however, that in the last stage of poisoning by digitalis irritability of the heart muscle accounts for the acceleration of the heart, while the fact that one pair of chambers is acted upon more readily than the other pair explains the arrhythmia. Again it has been held that the action of digitalis depends on the prolongation of the rest period of the heart which both conserves the strength of that organ and permits more time for the filling of the coronary arteries during diastole with increase of the cardiac nutrition.

This is not the case. Aconite prolongs diastole, which lessens the output of the heart, and none would think of using aconite as a heart stimulant for this reason. Moreover, the coronary arteries are

filled during ventricular systole but their finer ramifications are only supplied during diastole.

So that it must be here especially emphasized that the peculiar and beneficent action of the digitalis series is due almost wholly to its action in directly stimulating the heart muscle which results in this organ doing two and one-half times its usual work (Gottlieb and Magnus).

In the frog the action of digitalis in exciting cardiac contractions is much more marked than in mammals. Here the ventricular contractions become longer and stronger and the rest periods shorter and weaker until in lethal poisoning the heart stops in one prolonged systole with complete obliteration of the ventricular chamber. The slowing of the rhythm in the frog is due to prolonged systole. In mammals slowing in rhythm is due to both prolonged systole and diastole.

Slowing of the heart owing to increased diastolic rest would naturally diminish the total output of the heart but with medicinal doses of digitalis the stimulating effect on the heart muscle is much more marked than vagus stimulation. When diastole is much prolonged by an over-dose of the drug then the total output of the heart is actually lessened. In the normal mammalian heart dilatation of the ventricles is favored by digitalis but, in the heart dilated by disease, the dilatation may be overcome by the drug's action in stimulating the heart muscle.

The action of digitalis on the heart is more pronounced in dogs and sheep than in horses and cattle. The characteristic effect of digitalis is observed when it is applied locally to the isolated nerve-free apex, or when the vagi are previously cut or paralyzed by atropine, and when the spinal cord is destroyed. These facts show that the heart muscle is influenced. That the peripheral vagi are stimulated, is shown by the fact that an amount of galvanic stimulation of the vagi, ineffective before poisoning, will, after exhibition of digitalis, cause diastolic arrest of the heart. In regard to the vessels, experiments conducted on the terrapin exhibit the fact that when the vessels are deprived of their nerve supply, the heart excised, and an artificial circulation substituted, even then vascular contraction and retardation of flow will occur under the influence of digitalin added to the factitious blood. The resultant of the various actions of medicinal doses of digitalis is increased work of the heart, so that more blood is pumped throughout the body in any given unit of time.

Respiration.—The respiratory centres are only influenced by toxic doses, being first stimulated and then depressed by digitalis: the respiration is first rapid and deep, and later weak and imperfect.

Nervous System and Muscles.—These are not influenced by therapeutic doses of digitalis. Toxic quantities cause loss of reflex action, muscular weakness, vomiting, and convulsions in the frog. The first two phenomena are due to primary stimulation of the inhibitory reflex centres of Setschenow in the medulla, followed by general paralysis of the spinal cord, and direct depression of the motor nerves and muscles; while the convulsions are also caused by stimulation of the medulla.

Temperature.—The temperature is unaffected by medicinal doses. Toxic doses reduce temperature. Fever is lowered by large doses of digitalis, but it is rarely safe to use the drug as an antipyretic. Moreover, digitalis is sometimes inoperative as a heart stimulant in fever, because the functional activity of the vagus centres and peripheral terminations is depressed and insensitive to the action of the drug.

Kidneys.—Metabolism and Elimination.—The influence of digitalis on the amount of urinary secretion is variable. It may exert a slight stimulating effect upon the renal secreting cells. (Albumin and blood in urine in poisoning.) If general vascular tension is lowered (cardiac disease), digitalis will exert a diuretic action in consequence of increasing blood pressure. As a rule, it may be stated that if digitalis increases the systemic vascular tension more than that of the kidney (stimulating pressure in glomerules), diuresis follows. The effect of digitalis on tissue waste is uncertain and the mode of its elimination is unknown. Experiments relative to the composition of the urine are conflicting. The smooth muscle of the uterus is said to be stimulated to contraction by digitalis.

Cumulative Action.—Digitalis and strychnine are said to be cumulative in their action. Evidence is stronger in the case of the former drug than in that of the latter. By cumulative action is meant sudden transition from a therapeutic to a toxic effect. This may be due to three causes. 1. Tardy absorption. 2. Increasing susceptibility. 3. Delayed elimination and accumulation of the drug in the system. The cumulative action of digitalis is chiefly due to the latter cause. It should never be administered in full medicinal doses uninterruptedly for any considerable length of time.

Toxicology.—Poisoning may occur from large single doses within 3 to 10 hours of their ingestion, and last for 16 or more hours with a fatal result; or may appear suddenly after the administration for several days of large medicinal doses (cumulative action). A minimum fatal dose for the horse is about 3 vi. of digitalis, or gr.i.ss. of Homolle's digitalin. For dogs, 3 i. of digitalis, or gr. ¼ of digitalin. Cattle take enormous doses of digitalis by the mouth without toxic effect.

Large doses may, however, induce abortion and a dose of two and a half drams is said to have caused premature labor in a cow.

The symptoms exhibited are chiefly concerned with the digestion and circulation. They consist in dulness, lassitude, loss of appetite, nausea, flatulence, diarrhea, infrequent, full pulse (reduced 6-10 beats in the horse), and contracted pupils. There is vomiting in dogs. In fatal cases these symptoms are followed by severe colic and tympanites; rapid, feeble, dicrotic, irregular or intermittent pulse (120-140 in horses), while the heart may be heard and felt beating wildly and strongly, and a systolic blowing murmur can frequently be detected. This is due to mitral or tricuspid regurgitation caused by irregular contraction of the columnæ carnæ. The pulse is imperceptible because of the failure of the heart to fill the vessels. The extremities are cold, the eye is protruding, and salivation occurs. Bloody diarrhea is very often present and the urine may be supacid, as a chemical antidote, alcohol, opium, and aconite, which is the pressed. The breathing finally becomes difficult and death ensues within a few hours, or as late as several days.

Treatment.—Evacuation of the stomach and bowels. Tannic physiological antagonist in depressing the action of the heart and lowering blood tension. In addition, external heat should be applied and complete quiet and rest secured.

Administration.—In view of its slow absorption and elimination full doses of digitalis should not be given by the mouth oftener than twice daily or once in twenty-four hours, after its effect has been secured. Very large doses may be given, however, repeatedly, in case of threatened heart failure, by the subcutaneous method. The appearance of indigestion, nausea or dulness, and a decided fall in the pulse rate, should be a warning to stop the administration at once. The best preparations are the ticture, infusion, and fluid-extract.

Uses External.—Digitalis is occasionally employed as a poultice of the leaves, applied over the loins to promote diuresis, or in local inflammation, to contract vessels.

Uses Internal.—Among all other drugs digitalis stands out preeminently as *the* heart stimulant. None may take its place. Yet it has even been classified as a heart depressant. It may, however, exert a sedative effect upon a weak, rapid, irregular heart, by increasing the inhibitory and muscular power. Digitalis is indicated: (1) In all conditions where the heart is weak, irregular or intermittent, and the circulation sluggish; (2) as a diuretic, chiefly in dropsy secondary to cardiac disease, but also in that of renal origin; digitalis has also been used (3) as a hemostatic in internal hemorrhage, and

(4) to reduce temperature in fever; but, in both of the last two instances, with questionable advantage.

1. In syncope following disease, shock, injury or poisoning (aconite), digitalone is invaluable when injected subcutaneously together with alcoholic stimulants. Its action is slow, however, and in emergencies it should be reinforced by the use of strychnine or adrenalin. In acute diseases, digitalis is one of the most generally serviceable stimulants. The drug is peculiarly applicable in the second stage of pneumonia, because it strengthens the right ventricle, forces the blood through the obstructed lung, and prevents systemic venous engorgement and arterial anemia. In other words, it equalizes the circulation. Moreover, in stimulating the peripheral vagi, digitalis improves the tone of the bronchioles and prevents collapse of the air vesicles, and, by the same action, steadies the rhythm of the breathing. The drug is likewise an efficient circulatory stimulant in influenza of horses and distemper of dogs. Digitalis is frequently prescribed in chronic bronchitis and emphysema, to strengthen the heart and obviate passive pulmonary congestion and cough. Valvular disease of the heart, in its various phases, is the most common field of usefulness for digitalis in human medicine, but in veterinary practice these disorders are rarer and the exact lesion difficult or impossible to diagnose. In mitral stenosis and regurgitation and aortic stenosis, with lack of compensatory hypertrophy of the heart and evidence of circulatory disturbances, digitalis is clearly indicated. In these conditions the drug enables the heart to pump more blood into the arteries and prevents engorgement of the right heart and veins and the occurrence of dropsy. Digitalis is counter-indicated in aortic insufficiency, because in prolonging diastole it allows more time for the blood to flow back from the aorta through the leaky valve into the ventricle. As a general proposition, digitalis is inferior to aconite in simple cardiac hypertrophy. But this does not apply when enlargement of the heart is insufficient to compensate for valvular lesions.

Digitalis is extremely successful in palpitation of the heart (horses) following over-exertion, but is not appropriate in palpitation due to nervousness (dogs), or to indigestion. Digitalis may be exhibited to advantage in rheumatic fever and in endocarditis or pericarditis to quiet the heart and secure rest by prolonging diastole.

2. Digitalis is a valuable diuretic in dropsy of cardiac origin by stimulating the heart and overcoming venous stasis in the kidneys and elsewhere. Digitalis is frequently prescribed with squill and calomel (D., gr. i. of each) in pills for this purpose. It is often desirable to combine iron preparations with digitalis. Turbidity results from the action of iron on the tannic acid contained in digitalis

when in solution, but this can be removed by the addition of a little diluted phosphoric acid.

3. Since digitalis contracts the uterus and blood vessels, it has been prescribed in uterine hemorrhage, and to stop bleeding from other internal parts; but it is inferior to ergot on account of the general rise of blood tension. Hemoptysis, due to passive congestion of the lungs in mitral disease, is relieved by digitalis.

4. The use of digitalis in large doses as an antipyretic in fevers is not without danger and is inadvisable.

Strophanthus. Strophanthus.
(U. S. & B. P.)

The seed of Strophanthus Kombé Oliver (nat. ord. Apocynaceæ), deprived of its long awn.

Habitat.—Tropical Africa. There are eighteen species, and the seeds from at least two are found in commerce. This has led to some confusion, as the chemical and physiological properties of their different products vary to some extent.

Description.—Of a light fawn-brown color, with a distinct greenish tinge; about 15 Mm. long and 4 to 5 Mm. wide, 2 to 2.5 Mm. thick, lance-ovoid, obtuse at the base, gradually acuminate and somewhat acute at the summit, usually twisted, bearing on one side a ridge running from about the centre to the apex; silky-lustrous from a dense coating of closely appressed hairs, which mostly lie in longitudinal grooves on the surface; fracture short and somewhat soft, the fractured surface whitish and oily; kernel consisting of a thin endosperm enclosing straight cotyledons; odor slight, or heavy when the seeds are crushed and moistened; taste very bitter.

The endosperm, and often parts of the cotyledons, quickly assume a green color when crushed or cut and treated with concentrated sulphuric acid. Under the microscope the hairs are seen to be of a light greenish-brown color, 1 Mm. or less in length and to consist of but one thin-walled cell.

Constituents.—The chief one is (1) Strophanthin, $C_{31}H_{48}O_{12}$ (8-10 per cent.), a glucoside occurring in white or faintly yellowish crystalline powders, and having a very bitter taste. Soluble in water and alcohol, and insoluble in chloroform or ether. Decomposed by sulphuric acid into glucose and strophanthidin. Strophanthin is said to be contained only in S. Kombé. It varies in composition and strength and decomposes in solution. (2) Kombic acid. (3) An alkaloid, Ineine. (4) Tanghinin, occurring in rhombic prisms.

PREPARATION.

Tinctura Strophanthi. Tincture of Strophanthus. (U. S. & B. P.)

Made by digestion and percolation of strophanthus (100) with alcohol and water to make 1000. (U. S. P.)

Dose.—H. & C., 3 i.-iv. (4.-15.); D., ♏ii.-x. (.12-.6). The minimum doses should be used at first, since preparations vary in strength.

Strophanthinum. Strophanthin. (U. S. P.)

Dose.—H., gr. ⅕-½ (.012-.03); D., gr. ½₀₀ (.0003). The glucoside is not always pure and the dose is uncertain and must be given with caution in the smaller doses first.

Action External.—Strophanthus is a local anesthetic.

Action Internal.—Strophanthus is a gastro-intestinal irritant in large doses, like digitalis, and produces violent purging and sometimes vomiting. On account of its bitter qualities it may act in small medicinal doses as a stomachic, improving appetite and stimulating gastric secretion and motion.

Circulation.—The action of strophanthus on the circulation is very similar to that of digitalis, but it is a more powerful and uncertain heart stimulant and produces less vascular constriction. By its influence the heart beats are made more forcible, infrequent and regular. Diastole is prolonged and systole is strengthened but unaltered in time. Arterial tension is raised and the pulse wave is increased in volume and force. The physiological details are not so well ascertained as are those of digitalis, but it is known that strophanthus directly stimulates the heart muscle in moderate doses. The vessels are slightly contracted, but not nearly as much so as by digitalis. Increased blood pressure results mainly from the augmented heart's action. In poisoning, the peripheral vagi are paralyzed and vascular tension falls, owing probably to tetanic contraction of the ventricles. The heart is arrested in systole or diastole.

Nervous System.—Muscles and Respiration.—Strophanthus is a powerful muscle poison. Therapeutic doses increase muscular activity and tone, while toxic quantities paralyze voluntary muscles. Medicinal doses not only stimulate the voluntary muscles, but also the unstriped muscle of the heart, and to some extent that of the vessel walls. The nerve centres and trunks are unaffected except by the local application of strophanthus, which paralyzes the sensory nerve endings and muscular tissue. The respiration is uninfluenced by therapeutic doses of strophanthus, but in poisoning death some-

times takes place from respiratory failure following paralysis of the respiratory muscles.

Kidneys.—The kidneys are irritated by large doses of strophanthus and the urine is albuminous. Inflammation of the renal tubules with minute hemorrhages are found post mortem. The renal vessels are not dilated, and the oncometer shows that the size of the kidney is not increased. The drug stimulates the secretory cells of the renal tubules and causes diuresis directly as well as indirectly by increasing general blood pressure. The active principle is eliminated in the urine. A cumulative action in the lower animals and in man has been noted by several observers.

Uses Internal.—In general, it may be stated that the indications for strophanthus are identical with those for digitalis, but the former is not so certain in its effects. It is of value as a substitute for digitalis when this medicine is not well borne, and to replace digitalis temporarily in order to avoid its cumulative action. On account of the stimulant and diuretic properties of strophanthus, it is useful in mitral disease, cardiac dropsy, pericardial and pleural effusions, pulmonary edema, and chronic nephritis; but in heart disease digitalis should be tried first.

Convallaria. Convallaria. (U. S. P.)

Synonym.—Lily of the Valley, E.; muguet, Fr. The rhizome and roots of Convallaria majalis Linné (nat. ord. Liliaceæ).

Habitat.—United States, in the Alleghany Mountains, Europe and northern Asia.

Description.—Of horizontal growth and somewhat branched; about 3 Mm. thick, cylindrical, wrinkled, whitish, marked with few circular scars; at the annulate joint with about 8 or 10 long thin roots; fracture somewhat fibrous, white; odor peculiar, pleasant; taste sweetish, bitter and somewhat acrid.

Constituents.—Two glucosides; (1) Convallamarin ($C_{46}H_{44}O_{24}$), the active principle. A white powder, having a sweet, bitter taste, and soluble in water and alcohol. (2) Convallarin ($C_{34}H_{31}O_{11}$), occurring in prismatic crystals, soluble in alcohol, sparingly in water, and insoluble in ether. A purgative.

PREPARATION.

Fluidextractum Convallariæ. Fluidextract of Convallaria. (U. S. P.)

Made by maceration and percolation with diluted alcohol, and evaporation, so that 1 cc. = 1 gm. of the crude drug.

Dose.—H. & C., ʒ i.-iv. (4.-15.); D., ♏ v.-x. (.3-.6).

Action and Uses Internal.—Convallaria, by virtue of convallamarin, resembles digitalis in its action on the heart, vessels and kidneys, but is not so reliable and powerful. The indications for its use are the same as those for digitalis. In some cases it is successful where the latter drug has failed. Occasionally purging has resulted owing to the convallarin in convallaria. The fatal dose of convallamarin is stated by Marmé to be gr. ¼ to ½, (.015-.03) for dogs, and yet the dose recommended in veterinary text books is gr. ½ to 2 (.03-.12). The glucoside is not a pure principle and therefore varies in strength. For this reason the dose is uncertain and its use undesirable.

Scilla. Squill. (U. S. & B. P.)

Synonym.—Squills, E.; meerzwiebel, G.; scille, squille, Fr.; bulbus scillæ, P. G.

The bulb of Urginea maritima (Linné) Baker (nat. ord. Liliaceæ), deprived of its dry, membranaceous outer scales, and cut into thin slices, the central portions being rejected.

Habitat.—Southern Europe, on the shores of the Mediterranean.

Description.—In narrow segments about 5 cm. long, slightly translucent, yellowish-white or reddish, brittle and pulverizable when dry; tough and flexible after exposure to damp air; inodorous; taste mucilaginous, bitter and acrid.

Constituents.—Various active principles have been recovered, but it is doubtful if any completely represent the action of the drug. All possess some poisonous properties. Merck sells three substances derived from squill: (1) Scillitoxin, a glucoside. (2) Scillipicrin. (3) Scillin. In addition, the drug contains mucilage.

Squill Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15.); Sh., gr.xv.-xxx. (1.-2.); D., gr.i.-v. (.06-.3).

PREPARATIONS.

Fluidextractum Scillæ. Fluidextract of Squill. (U. S. P.)

Made by maceration and percolation with acetic acid and water, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15.); Sh., ♏xv.-xxx. (1.-2.); D., ♏i.-v. (.06-.3).

Tinctura Scillæ. Tincture of Squill. (U. S. & B. P.)

Made by maceration and percolation of squill, 100; with alcohol and water to make 1000. (U. S. P.)

Dose.—H., 3 vi.-℥ i.ss. (24.-45.); C., ℥ i.ss.-iii. (45.-90.); Sh., 3 i.ss.-iii. (6.-12.); D., ♏v.-xxx. (.3-2.).

Syrupus Scillæ. Syrup of Squill. (U. S. & B. P.)

Made by boiling and filtering vinegar of squill, 450; adding sugar, 800; straining and adding water to make 1000. (U. S. P.)

Dose.—H., ʒ ss. (15.); D., 3 ss.-i. (2.-4.).

Incompatible with ammonium carbonate.

Syrupus Scillæ Compositus. Compound Syrup of Squill. (U. S. P.)

Synonym.—Coxe's Hive Syrup. Fluidextract of squill, 80; fluidextract of senega, 80; antimonium and potassium tartrate, 2; purified talc, 20; sugar, 750; water to make 1000.

Dose.—D., ♏v.-xxx. (.3-2.).

Pil. Ipecachuanhae cum Scilla. (B. P.)

Contains 5 per cent. opium. Dogs, gr.ii.-viii. The compound syrup (U. S. P.), or the pill of ipecac with squill (B. P.), are good cough remedies for dogs.

Action Internal.—Gastro-intestinal Tract.—Therapeutic doses do not exert any effect, but toxic quantities cause vomiting and purging in dogs, with fall of temperature, stupor, intermittent paralysis, convulsions, suppression or scanty secretion of bloody urine, and death within 12 or 15 hours. Lesions of gastro-enteritis and congestion of the kidneys are found after death.

Circulation.—The action of squill on the heart and vessels is practically identical with that of digitalis.

Respiration.—Clinical experience, rather than physiological experiments, has shown that squill acts as an expectorant during its elimination from the bronchial mucous membrane, thereby increasing secretion and vascularity.

Kidneys.—Squill is eliminated mainly by the kidneys, and in its excretion directly stimulates them and increases the amount of urine. In toxic doses it produces acute parenchymatous nephritis and urinary suppression. Squill is a more powerful diuretic than digitalis.

Uses Internal.—Squill is useful in ascites of dogs, resulting from valvular lesions or otherwise, to stimulate the heart and cause diuresis. It may be given to advantage in pill with digitalis, calomel, and extract of hyoscyamus—one grain of each. Small doses of squill are often exhibited to dogs in the second stage of acute bronchitis, and occasionally to horses, as an expectorant; and in large doses as an emetic for dogs in the form of the simple or compound syrup. The drug is indicated in bronchitis with scanty secretion, or when exudation is excessive to improve the tone of the bronchial mucous membrane.

Class 2.—Decreasing the Force and Frequency of the Heart.

Aconitum. Aconite.

Synonym.—Aconiti radix, B. P.; racine d'aconit, Fr.; tubera aconiti, P. G.; eisenhutknollen, G. The tuber of Aconitum Napellus Linné (nat. ord. Ranunculaceæ). Should yield not less than 0.5 per cent. of aconitine.

Habitat.—Northwestern North America, Europe and Asia in mountainous regions, and cultivated in the United States for its showy flowers.

Description.—From 10 to 20 Mm. thick at the crown; conically contracted below; from 50 to 75 Mm. long, with scars or fragments of radicles; dark brown externally, whitish internally, with a rather thick bark; the central axis about seven-rayed; without odor; taste at first sweetish, soon becoming acrid and producing a sensation of tingling and numbness which lasts for some time.

Constituents.—The alkaloid representing the action of the drug is aconitine ($C_{33}H_{45}NO_{12}$?), which is precipitated by ammonia from an aqueous solution of an alcoholic extract of the root of various species. It is a colorless, crystalline, or amorphous, gray powder, almost insoluble in water, and soluble in 22 parts of alcohol, in 44 parts of ether, and 1 part of chloroform. Its salts are soluble in water. Aconitine or its solutions, unless very dilute, are too poisonous to be tasted.

Commercial preparations vary in purity and strength, and since it is extremely poisonous (an Indian arrow poison) its internal administration is undesirable. Pseudo-aconitine ($C_{36}H_{49}NO_{11}$), aconine ($C_{26}H_{39}NO_{11}$), and other alkaloids in combination with aconitic acid ($C_6H_6O_6$), have been obtained from aconite, but their identity and chemistry are uncertain.

Aconite Dose.—H. & C., gr.iii.-xx. (.2-1.3); D., gr. $\frac{1}{10}$-ii. (.006-.12).

Aconitinæ Nitras. (Squibb.) Subcutaneously.

H., gr. $\frac{1}{30}$ (.002); D., $\frac{1}{200}$-$\frac{1}{100}$ (.0003-.0006).

Aconitina. Aconitine. (U. S. & B. P.)

Occurs in colorless or white rhombic tables or prisms, possessing no odor, and permanent in the air. Almost insoluble in water.

Aconitine often contains a considerable proportion of aconine and benzaconine, and so varies in activity, which is a great objection to the use of one of the most powerful drugs known. (Vid. supra.)

PREPARATIONS.

Tinctura Aconiti. Tincture of Aconite. (U. S. & B. P.)

Synonym.—Teinture de racine d'aconit, Fr.; eisenhuttinktur, G. Made by maceration and percolation of aconite, 100; with alcohol and water to make 1000. (U. S. P.)

Dose.—H., ♏xx.-3 i. (1.3-4.); C., 3 ss.-i.ss. (2.-6.); Sh. & Sw., ♏x.-xx. (.6-1.3); D., ♏ii.-x. (.12-.6).

Fluidextractum Aconiti. Fluidextract of Aconite. (U. S. P.)

Made by maceration and percolation with alcohol and water, and evaporation. Assayed so that each 100 c.c. contains 0.4 gm. aconitine.

Dose.—H. & C., ♏iii.-xx. (.2-1.3); D., ♏1/10-ii. (.006-.12).

Unguentum Aconitinæ. (B. P.) (2 per cent.)

Linimentum Aconiti. (B. P.)

Fleming's Tincture. (Non-official.) (79 per cent.)

Dose.—H., ♏vii.-xv. (.5-1.); D., ♏¼-ii. (.015-.12).

ACONITE AND ACONITINE.

Action External.—Aconite or aconitine applied to mucous membranes, raw surfaces or the unbroken skin, irritates and then paralyzes the nerves of touch and temperature. This is evidenced in the human subject by a sensation of tingling and burning, followed by numbness and local anesthesia.

Action Internal.—Digestive Tract.—Aconite in medicinal doses has no special effect on the digestive organs. Toxic doses produce nausea and retching, and, in animals capable of the act, vomiting.

Circulation.—The chief therapeutic value of aconite depends upon its influence over the heart and vessels. It reduces the frequency of the cardiac pulsations and lowers blood tension owing to stimulation of the vagus centre in the medulla. This is the chief effect of aconite on the circulation in medicinal doses. The action on the heart is not to weaken it in therapeutic doses but simply to slow it—pure inhibition. It is improper, therefore, to classify aconite as decreasing the force of the heart, save in toxic doses. In medicinal doses it makes the systolic contractions more powerful and causes increased dilatation in diastole. It may, however, be regarded as a circulatory depressant in slowing the heart since it thus weakens blood pressure. In fatal poisoning by the drug, however, the action of the heart becomes rapid and irregular. The time of contraction of the auricles does not correspond with ventricular contraction, and the lack of rhythm and irregularity increase until the heart is thrown into delirium and fibrillation.

Depending on this condition of the heart, the blood pressure is naturally subject to momentary variations. The rapidity and irregularity of the heart are due to paralysis of the inhibitory apparatus and great irritability of the cardiac muscle, with weakened contraction and conduction, occurring simultaneously.

The vasomotor centre is slightly stimulated by medicinal doses, but the blood pressure is lowered through the slowing of the heart beats, prolonged diastole, and lessened cardiac output. In poisoning there is paralysis of the vasomotor centres.

The heart is arrested in diastole, but death immediately results from respiratory failure.

Nervous System.—The most striking effect of aconite on the nervous system (in man) consists in tingling followed by loss of sensation and temperature sense after large medicinal doses. This phenomenon is due to stimulation succeeded by depression of the sensory nerve terminations. The drug is not comparable with opium, since doses large enough to produce a general anodyne action are dangerous.

Poisonous doses of aconite cause muscular twitching and loss of motor power, which result from excitation, and finally paralysis of the motor nerve endings. Convulsions occur in poisoning. These are thought to follow stimulation of the medulla as the higher cerebral centres are often unimpaired. Stimulation and then depression of the lower divisions of the nervous system—especially the medulla and peripheral sensory and motor nerves—describe the general effect of aconite. Its influence over the cord is uncertain.

Respiration.—The breathing of animals under the influence of aconite resembles that observed after section of the vagi. The respiration is slow and labored; the expiration is prolonged, and is succeeded by a considerable interval before the next inspiration. This condition is brought about by depression of the medullary respiratory centres.

Temperature.—The bodily heat is reduced by aconite in fever, after medicinal doses, and in poisoning by the drug. Retarded circulation with possibly some action on the heat regulating centres and therefore heat dissipation, probably explain the antipyretic action.

Skin.—Aconite sometimes produces slight diaphoresis. The cause of this action is unknown.

Kidneys and Elimination.—The urinary flow is somewhat increased, especially in fever. The cause is uncertain. Aconitine is eliminated in the urine.

Toxicology.—The minimum fatal dose of aconite is about 3 i. for the horse; gr. xx. for medium sized dogs; and gr.v.-vi. for cats.

The smallest fatal dose recorded in man is a teaspoonful of tincture of aconite (U. S. P. 1890), equivalent to about gr. xxx. of the crude drug. The minimum lethal quantity of aconitine is gr. $\frac{1}{16}$ for man, and about the same for cats. For dogs it is from gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$. The writer has found that cats will live from fifteen minutes to half an hour after receiving the smaller deadly doses under the skin, but large doses produce death immediately by paralyzing the heart. Large therapeutic doses cause, in horses, restlessness, pawing the ground, shaking of the head, champing of the jaws, increased secretion of salivary mucus, and attempts at swallowing, probably owing to the peculiar sense of irritation produced by the drug in the throat. Nausea and retching are observed in all animals, while vomiting occurs in dogs and cats. The pulse and respiration are weakened and generally retarded. After lethal doses these symptoms are intensified. We observe violent retching, frequent and difficult attacks of swallowing, ejection of frothy mucus from the mouth, copious sweating in horses; pulse first weak and infrequent, later rapid, running and almost imperceptible; respiration slow, interrupted, and shallow, and reduction of temperature. Death is preceded by muscular twitchings in the horse and loss of strength, so that the subject falls and is unable to rise; or in the case of cats and rabbits, the animals jump vertically into the air, topple over backwards and go into convulsions, lying helpless on their side. The labial muscles are retracted, and the lips drawn back, showing the teeth covered with foam. The face is anxious, the eyeballs are retracted or protruded, and the pupils more commonly dilated. Death takes place usually from asphyxia, occasionally from syncope. The post-mortem appearances are simply those resulting from asphyxia.

Treatment.—Evacuate the stomach by siphon. Emetics are contraindicated as disturbing the heart. Cardiac and respiratory stimulants are to be given subcutaneously, as alcohol, ammonia, ether, digitalone, atropine and strychnine, in addition to inhalation of amyl nitrite. The patient must be kept quiet, and artificial respiration done if practicable and necessary. Experimental evidence seems to prove atropine the most valuable single antidote to aconite in stimulating the respiratory and vasomotor centres.

Uses External.—Aconite may be applied in liniment (fluid extract of aconite, 40; chloroform liniment, 60) to relieve pain of an inflammatory, neuralgic, or rheumatic character; or as aconitine in ointment (2-4 per cent.) for the same purposes. Aconitine is very expensive, however. Care must be exercised to prevent undue absorption and poisoning.

Uses Internal.—Aconite fills certain indications which no other drug does. It is useful in fever because:

1. It diminishes the frequency of the heart and weakens the circulation (reduces blood pressure).

2. It lowers temperature and produces sweating and diuresis.

3. It relieves pain and restlessness to some extent.

Aconite is particularly applicable, conjoined with sweet spirit of nitre, in the first stages of febrile diseases; in those attacking the young; and in those of self-limited and short duration, viz., coryza, laryngitis, pharyngitis, pleuritis, bronchitis and pneumonia uncomplicated with influenza. It is also indicated in the initial period of acute muscular rheumatism, enteritis and peritonitis (combined with opium), and in mammitis, lymphangitis, and laminitis. Spasmodic and painful disorders, as colic, are relieved more successfully by powerful anodynes and antispasmodics (opium and belladonna).

In chronic or long continued fevers, the use of aconite should not be persisted in, but it should be given at the very outset of fevers and repeated frequently in small doses. ℥xv. for the horse, and ℥ii. for the dog, every fifteen minutes for two hours, and afterwards ℥xxx. for the horse and ℥iii. for the dog, hourly, being governed, however, by the condition of the pulse and temperature and the physiological effects. Aconite is a useful sedative in some cardiac disturbances. It quiets nervous palpitation, and that form resulting from hypertrophy of the heart. It can be administered to advantage in the first stages of acute pericarditis and endocarditis.

Veratrum. Veratrum.*

Synonym.—Veratri viridis rhizoma, B. P.; veratrum viride, American hellebore, green hellebore root, Indian poke root, E.; grüner germer, G. veratri albi rhizoma, white hellebore root, E.

The rhizome and roots of Veratrum viride Aiton or Veratrum album Linné (nat. ord. Liliaceæ).

Description.—Rhizome upright, obconical, simple or divided, from 2.5 to 7. Cm. long and 2 to 5 Cm. thick; externally blackish-gray, internally grayish-white; showing numerous short, irregular wood-bundles. Roots emanating from all sides of the rhizome, numerous, shrivelled, light yellowish-brown; about 10 to 20 Cm. long and 2 Mm. thick. Inodorous, but strongly sternutatory when powdered; taste bitterish and very acrid.

Constituents.—1. Veratrine ($C_{32}H_{49}NO_9$), a pure alkaloid. 2. Jervine ($C_{26}H_{37}NO_3$), a pure alkaloid. 3. An impure alkaloid,

* Great confusion exists concerning the alkaloids in veratrum because writers apply different names to the same alkaloids.

veratroidine, a mixture of rubijervine and an inert resin. 4. Pseudojervine. 5. Rubijervine. 6. A resin, a gastro-intestinal irritant.

Veratrum Dose.—H. & C., 3 ss.-i. (2.-4.); Sh. & Sw., gr.xx.-xxx. (1.3-2.); D., gr. $\frac{1}{10}$-i. (.006-.06).

PREPARATIONS.

Fluidextractum Veratri. Fluidextract of Veratrum.
(U. S. P.)

Made by maceration and percolation with alcohol, and evaporation, so that 1 cc. = 1 gm. of the crude drug.

Dose.—H. & C., 3 ss.-i. (2.-4.); Sh. & Sw., ♏xx.-xxx. (1.3.2.); D., ♏$\frac{1}{10}$-i. (.006-.06).

Tinctura Veratri. Tincture of Veratrum.
(U. S. & B. P.)

Made by maceration and percolation of veratrum viride, 100; and alcohol to make 1000. (U. S. P.)

Dose.—H. & C., 3 ss.-i. (15.-30.); Sh. & Sw., 3 ii.-iv. (8.-15.); D., ♏v.-xv. (.3-1.)

JERVINE.

Action Internal.—Digestive Tract.—Large doses cause salivation, but have little effect on the stomach or bowels.

Circulation.—Jervine is a powerful depressant to the heart muscle and the vasomotor centres. Large doses, therefore, weaken and slow the pulse and lower vascular tension.

Respiration.—The alkaloid is also a profound respiratory depressant, and death occurs from asphyxia in poisoning, the heart continuing to beat after cessation of breathing.

Nervous System.—In poisoning by jervine, animals exhibit muscular tremors and weakness, and finally fall from loss of muscular power. Lying prostrate on the ground in a paralytic state, they are attacked by clonic convulsions. The paralysis is attributable to depression of the cells of the inferior cornua, while the convulsions are due to disturbance of the cerebral circulation, or stimulation of the cerebral motor tract. The muscles and nerves are unaffected by jervine, but there is partial anesthesia of spinal origin observed just before death.

VERATROIDINE.

Action Internal.—The alkaloid is a decided gastro-intestinal irritant and produces vomiting in animals capable of the act, and often purging.

Circulation.—Veratroidine mainly influences the cardiac inhibitory apparatus. When artificial respiration is practised, so that the effect of the substance on the respiratory centres will not overcome the action on the circulation, it is found that the alkaloid slows the heart's action in moderate doses by stimulating the pneumogastric centres. Large toxic doses, on the other hand, paralyze the vagus nerve endings in the heart, and the cardiac pulsations therefore become very frequent. The vasomotor centres are uninfluenced by ordinary quantities of veratroidine.

Respiration.—The depressing action of veratroidine on the respiratory functions is more marked than that exerted on the heart, so that, unless artificial respiration is sustained, asphyxia supervenes, and this leads to vasomotor spasm and great rise of blood pressure. Death ensues from respiratory failure.

Nervous System.—The influence of veratroidine upon the nervous system is similar to that of jervine, but the spasmodic phenomena are not so prominent.

VERATRUM.

Action Internal.—The action of the drug is a resultant of the action of veratrine*, jervine and veratroidine.

Circulation.—The most noteworthy therapeutic value of veratrum viride depends upon its effect on the circulation. It first lowers the force (jervine), and, if continued, the frequency (veratrine*, protoveratrine*, veratroidine and jervine) of the pulse, and also reduces vascular tension (jervine). Veratrum is considerably more powerful depressant to the circulation than aconite, which does not directly lessen arterial pressure. Veratrum is, however, inferior to aconite for general purposes, as it does not possess the anodyne, diaphoretic, or diuretic properties peculiar to the latter drug.

The temperature is reduced several degrees by large doses of veratrum.

Toxicology.—The symptoms exhibited in veratrum poisoning are: salivation, vomiting, or attempts at vomiting, purging, abdominal pain, muscular weakness, difficulty in progression, loss of power and general paralysis, muscular tremors and spasms, and occasionally convulsions. The pulse is unaltered in rate at first, but later becomes infrequent and compressible and finally rapid, thread-like and running. The respiration is shallow, the temperature reduced, the skin is cold and clammy; there is semi-consciousness, loss of sight and death from asphyxia.

* See p. 420.

Treatment should be pursued with the stomach tube and cardiac and respiratory stimulants, as alcohol, strychnine and atropine; tannic acid as a chemical antidote; opium to subdue pain; and demulcents to relieve local irritation of the digestive tract. Warm water should be given the smaller animals to wash out the stomach and to assist vomition, and quietude should be enforced. In man, fatal poisoning is rare, since the drug is spontaneously vomited. The same would probably apply to dogs. Recovery has ensued in horses after ingestion of two ounces of veratrum root.

Administration.—It is advisable to give small doses of the tincture or fluid extract hourly. In the case of the smaller patients, the dose should be preceded by the administration of a correspondingly small dose of laudanum (♏v.-x.) to prevent vomiting.

Uses Internal.—The alkaloids of veratrum are difficult to obtain in their purity, and are not used in practice.

The drug is applicable as a circulatory sedative at the outset of sthenic diseases afflicting strong, plethoric animals. Veratrum bleeds an animal into its own vessels by causing vascular dilatation. The indications are similar to those applying to venesection, and are therefore limited. In some cases of acute diseases, included within the limits defined above, it may prove of service to cut short or even abort the attack. Aconite is usually a safer and better drug to use, however.

In this list may be placed sthenic pneumonia, cerebritis, laminitis, puerperal fever, and, when veratrum is combined with opium to obviate stimulation of peristaltic action, enteritis, peritonitis, and abdominal wounds and injuries. Veratrum is said to relieve pain, lower temperature and lessen the duration of acute rheumatic fever.

Veratrum Album.*

Synonym.—Veratri albi rhizoma, white hellebore root, E.

Habitat.—Europe (used on the continent).

Constituents.—1. Protoveratrine ($C_{32}H_{51}NO_{11}$), an alkaloid acting like veratrine on the heart. 2. Jervine. 3. Rubijervine. 4. Pseudojervine and other alkaloids. The Germans recommend it to be given as an emetic to swine, in milk, gr.v.-xx. (.3-1.3), and as an emetic to cattle, ʒ iv.-vi. (16.-24.). Its use is, however, attended with some danger in these doses.

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* Veratrum (U.S.P.) now includes both Veratrum viride (American Hellebore) and Veratrum Album (White Hellebore).

Veratrina. Veratrine.† (U. S. & B. P.)

A mixture of alkaloids obtained from the seed of Asagræa officinalis (Schlechtendal et Chamisso) Lindley (nata. ord. Liliaceæ). (U. S. P.)

Derivation.—Obtained from the seed by alcohol, which is recovered by distillation, and the residue is treated with water to precipitate resins; filtered, and veratrine is precipitated from the filtrate by ammonia. It is further purified by solution in water, decolorization, and reprecipitation.

Properties.—A white, or grayish-white, amorphous, or semicrystalline powder; odorless, but causing intense irritation and sneezing when even a minute quantity reaches the nasal mucous membrane; having an acrid taste, and leaving a sense of tingling and numbness on the tongue. Permanent in the air. Very slightly soluble in cold or hot water; soluble in 2.2 parts of alcohol, and very soluble in boiling alcohol; also soluble in 3 parts of ether, and in 1 part of chloroform.

Dose.—H., gr. ss.-ii. (.03-.12); C., gr. ii.-v. (.12-.3); D., gr. $\frac{1}{50}$-$\frac{1}{10}$ (.0012-.006).

The smaller doses to be given subcutaneously.

PREPARATIONS.

Oleatum Veratrinæ. Oleate of Veratrine, 2 per cent. (U. S. P.)

Unguentum Veratrinæ. (U. S. & B. P.) (4 per cent., U. S. P.)

Action External.—Veratrine is a powerful irritant. If inhaled in minutest quantity it causes sneezing and a mucous, or bloody discharge. When injected under the skin, veratrine occasions suffering and restlessness. Rubbed into the skin or applied to a mucous membrane or raw surface, it produces redness and pain followed by local anesthesia.

Action Internal.—Here again veratrine is an intense irritant. After ingestion of large doses, there are salivation, violent vomiting, in animals capable of the act; often severe purging, pain, collapse, fall of temperature and other symptoms common to gastro-enteritis.

Nervous System and Muscles.—Veratrine is a poison to the medulla, spinal cord, motor and sensory nerves and muscles, first exalting and then depressing and paralyzing their functional activity. The cerebrum escapes its influence. Spasms and convulsions

† This substance contains the pure alkaloid veratrine ($C_{32}H_{49}NO_9$), veratrine of Wright ($C_{37}H_{53}NO_{11}$), and cevadine. The action described is that of pure veratrine.

occur in veratrine poisoning, in the stage of motor excitement, while paralysis follows depression of the nerves and muscles. The action of the substance begins and ends sooner in the nerves than the muscles. The effect of veratrine on voluntary muscle is peculiar. A tracing of a muscle during contraction shows that the latent period, and that of ascent, is unaltered; but the amount of contraction is much augmented, as shown by the increased height of the curve; and the time of relaxation is greatly prolonged.

Circulation.—Veratrine affects the heart muscle much as it does the striped muscle, and the vagus nerve similarly to the spinal nerves. The cardiac muscle, vagus and vasomotor centres are primarily stimulated, while later the heart muscle, vagus endings and vasomotor centres are depressed and paralyzed. Three conditions have been noted in relation to the pulse, corresponding to different stages in the action of veratrine. 1. A small dose may induce a temporary rise of pulse rate, force and tension, by stimulation of the cardiac muscle and vasomotor centres. 2. Large doses are followed by slowing and weakening of the pulse. The vagus centre is stimulated and the heart muscle depressed. 3. Towards the end of fatal poisoning the pulse becomes weak, thread-like, rapid and irregular from paralysis of the heart muscle, vagus endings and vasomotor centres. It sometimes happens, however, that the pulse remains weak and slow in this stage because the paralyzing influence of the substance on the heart muscle prevents quickening of the heart even after the removal of inhibitory control. The heart is dilated and irresponsive to galvanism, after death, as are also the voluntary muscles.

Respiration.—Lethal doses paralyze the respiratory centres and death occurs from respiratory arrest. The breathing may be quickened by small doses of veratrine, owing to transient stimulation of the respiratory centres and vagus nerve endings in the lungs.

Toxicology.—The symptoms of poisoning are referable to the action of veratrine on the digestive, nervous and muscular apparatus, heart, and respiratory organs. They include nausea, salivation, clammy sweating, excessive vomiting in dogs, cats and cattle, attempts at vomiting in the horse, abdominal pain, severe purging, muscular twitchings or convulsions (excited by external stimuli), loss of muscular power and paralysis. The pulse, at first weak and infrequent, becomes thready, rapid and irregular. The temperature is reduced and the respiration is weak and slow. Death occurs in convulsions or paralysis. One-sixteenth of a grain has caused alarming symptoms in man. The minimum fatal dose is about one grain for dogs. One grain subcutaneously, or five to six grains by the mouth, produce poisonous symptoms in horses.

Treatment.—External heat; respiratory and cardiac stimulants should be employed subcutaneously. Potassium carbonate and demulcent drinks are to be given internally.

Uses External.—Veratrine is of trivial value, since its therapeutic application is narrowly limited. It is occasionally useful in the official ointment, or in greater strength (gr. xl. to ʒ i.) for its local anæsthetic action applied over rheumatic joints. It may be employed also as a simple rubefacient. An aqueous solution of veratrine sulphate, or an alcoholic dilution of the pure alkaloid, is recommended by Ellenberger and other noted Germans in shoulder lameness, myalgia, and chronic rheumatic affections of the horse, to be injected every alternate day, or oftener, into the muscular tissue over the seat of the trouble. The animal should be led about for fifteen or thirty minutes while the pain of the treatment lasts. The initial dose is gr. ⅔ (0.4 Gm.), to be increased to gr. 1½ (0.1 Gm.).

Uses Internal.—Veratrine has been employed as a cardiac sedative and antipyretic in pneumonia, acute rheumatism, and in other sthenic disorders, but it is inferior for these purposes to aconite or veratrum, and its other effects are undesirable. The remedy is lauded by foreign authorities as an emetic and cathartic for cattle in impaction of the third stomach, and in conditions where it is desirable to quickly unload their digestive apparatus. For this purpose P. Cagny advises veratrine, gr. 2½-3 (.15-.20), subcutaneously, to be followed if necessary by daily doses of grs. 5-7½, (0.3-0.5 Gm.) in mucilaginous drinks by the mouth. The same writer finds the drug useful in "broken wind." Veratrine stimulates intestinal secretion and peristalsis in the horse, but is inferior to eserine and pilocarpine in that animal as a quickly acting cathartic.

SECTION VII.—DRUGS ACTING ON THE RESPIRATORY ORGANS.

Ipecacuanha. Ipecac. (U. S. & B. P.)

Synonym.—Ipécacuanha, racine brésilienne, Fr.; brechwurzel, ruhrwurzel, G.

The root of Cephaëlis Ipecacuanha (Brotero) A. Richard (nat. ord. Rubiaceæ).

Habitat.—South America from Brazil to Bolivia, and New Granada. Cultivated in India.

Description.—The dried root, to which may be attached a portion of the stem not exceeding 7 Cm. in length, of *Cephaëlis Ipe-*

cacuanha (Brotero) A Richard (Fam. *Rubiaceæ*), known commercially as *Rio, Brazilian,* or *Para ipecac,* or the corresponding portion of *C. acuminata* Karsten, known commercially as *Carthagena ipecac,* yielding, when assayed by the process given below, not less than 2 per cent. of ipecac alkaloids.

Rio Ipecac.—In pieces of irregular length, rarely exceeding 25 Cm.; stem-portion 2 to 3 Mm. thick, light gray-brown, cylindrical and smoothish; root-portion usually red-brown, occasionally blackish-brown, rarely gray-brown, 3 to 6 Mm. thick, curved and sharply flexuous, nearly free from rootlets, occasionally branched, closely annulated with thickened, incomplete rings, and usually exhibiting transverse fissures, with vertical sides, through the bark; fracture short, the very thick, easily separable bark whitish, usually resinous, the thin, tough wood yellowish-white, without vessels; odor very slight, peculiar, the dust sternutatory; taste bitter and nauseous, somewhat acrid.

Carthagena Ipecac.—Similar to Rio Ipecac, but about one-half thicker, dull gray externally, with thinner, merging annulæ, and the fractured surface of the bark gray.

Constituents.—1. The alkaloid Emetine ($C_{14}H_{18}(CH_3)NO_2$), existing to the extent of 1-2 per cent., and representing in the main the action of the crude drug. It is a white, odorless, uncrystallizable powder, with a bitter, burning taste, and soluble in alcohol and chloroform; less so in ether, and very slightly in water, turning yellow on keeping. The impure commercial alkaloid occurs in brownish-red transparent and deliquescent scales, very soluble in water. Really emetine is composed of three alkaloids: (1) Pure emetine ($C_{14}H_{18}(CH_3)NO_2$). (2) Cephaeline ($C_{14}H_{19}NO_2$), resembling emetine in action. (3) Psychotrine, which is inert. 2. An amorphous, bitter glucoside. 3. An astringent, ipecacuanhic acid. 4. A volatile oil, starch, gum, tannin, coloring matter, etc. Hemidesmus exists as an impurity, it is cracked, not annulated; also bitter almond powder, which exhales the odor of prussic acid when wet. Emetine (non-official) is rarely used.

Dose of Powdered Root.—H., 3 i.-ii. (4.-8.); C., 3 ii.-iv. (8.-15.); Sh., 3 ss.-i. (2.-4.); D., gr. ss.-ii. (.03-.12).

Emetic.—D. & Sw., gr. xv.-xxx. (1.-2.).

PREPARATIONS.

Fluidextractum Ipecacuanhæ. Fluidextract of Ipecac. (U. S. P.)

Made by maceration and percolation with alcohol and water, evaporation of a portion of the percolate, solution of the residue in the reserved portion of the percolate, and addition of alcohol and water. Assayed and enough

menstruum added so that the fluidextract shall contain 1.75 per cent. of alkaloids from ipecac. *Dose*—Same as powdered root.

Extractum Ipecacuanhæ Liquidum. (B. P.)

Dose.—One-half that of the U. S. P. fluidextract.

Syrupus Ipecacuanhæ. Syrup of Ipecac. (U. S. P.)

Fluid extract of ipecac, 70; acetic acid, 10; glycerin, 100; sugar, 700; water to make 1000.

Dose.—D. (expectorant), ℥xv.-℥i. (1.-4.).

Vinum Ipecacuanhæ. Wine of Ipecac. (U. S. & B. P.)

Fluid extract of ipecac, 100; alcohol, 100; white wine, 800. (U. S. P.)

Dose.—Same as syrup of ipecac.

Pulvis Ipecacuanhæ et Opii. (U. S. & B. P.) (See opium.)

Tinctura Ipecacuanhæ et Opii. (See opium.)

Action External.—Ipecac, and still more emetine, are decided irritants when applied to mucous membranes, raw surfaces, or even to the unbroken skin; causing, variously, hyperemia, vesication, pustulation, and ulceration, according to their strength and the mode of application. Ipecac is said to possess some antiseptic properties not resident in emetine.

Action Internal.—Digestive Tract.—Ipecac is naturally a local irritant in the alimentary canal as well as externally. It increases the flow of saliva and gastric juice, besides dilating the blood vessels of the stomach. Small doses are stomachic, improving the digestion and tone of the gastric mucous membrane, and, in some cases, minute quantities are anti-emetic in allaying vomiting. Large doses, on the other hand, cause a little nausea and free vomiting. It is probable that emetine is not, as frequently stated, a specific emetic; that is, does not act directly on the vomiting centre, although vomiting is produced, when emetine is thrown into the blood, by means of its elimination through the stomach. This is substantiated by the following facts: (1) Emetine is recovered in the first vomitus after its subcutaneous injection. (2) Vomition does not occur so rapidly, and more emetine is required, when the alkaloid is injected in place of being ingested. (3) Furthermore, when the vagus is previously divided, vomiting does not follow hypodermic medication of emetine. The act does, however, follow the administration of apomorphine and tartar emetic under similar conditions. Therefore it is probable that in whatsoever way ipecac is exhibited, vomiting proceeds from direct irritation of the stomach or the vagus endings situated therein. Ipecac and emetine do not act so promptly as zinc sulphate or apo-

morphine (under the skin). The latter are accordingly preferable as evacuants in poisoning. Compared with tartar emetic, ipecac is less persistent and prostrating in its effect. It is probably the mildest emetic at our command. Ipecac and emetine increase secretion and cause hyperemia and purging, sometimes of a bloody character, in their passage through the bowels. Gastro-enteritis may follow the administration of large quantities to dogs. Experimental evidence has apparently shown that ipecac is an hepatic stimulant (cholagogue), increasing the secretion of bile. This action is doubtful.

Circulation.—Medicinal doses have no influence on the circulation. Lethal doses paralyze the heart muscle. The act of vomiting, nevertheless, may slightly depress the heart.

Respiratory Organs.—The lungs are often found intensely hyperemic after death by ipecac poisoning. Not only this; portions are seen to be collapsed and consolidated. In therapeutic doses the pulmonary mucous membrane is stimulated during its elimination and is made more vascular; the secretion of bronchial mucus is increased and cough is reflexly excited. Ipecac is thus strictly a stimulating expectorant in so far as its action on the bronchial mucous membrane is concerned; but it is, perhaps unfortunately and misleadingly, classed by some (Brunton) as a depressing expectorant because of the side influence on the circulation.

Skin.—Ipecac is mildly diaphoretic in addition to and independent of this action common to nauseants in general.

Toxicology.—The following toxic phenomena are exhibited by animals: vomiting, loss of muscular power and paralysis, increased, followed by diminished reflex activity, failure of heart and respiration, and post mortem evidences of congestion and inflammation of the lungs and intestines. Three ounces of ipecac have killed a horse, and two grains of emetine have proved fatal to a dog.

Uses.—The indications for the therapeutic employment of ipecac may be described under the following heads:

1. Emetic and anti-emetic.
2. Expectorant.
3. Diaphoretic.
4. Empirically in dysentery and chronic diarrhea.

1. Powdered ipecac is a good agent for dogs, cats and pigs, given in luke-warm water, in repeated doses if necessary, to empty an overloaded stomach. Also in acute bronchitis and laryngitis of dogs and cats, when the patient is endangered by accumulation of secretion, ipecac, by the forcible expulsion attending vomiting, removes secretion from the upper respiratory tract and clears out the stomach of any secretion which may have been swallowed. Ipecac is effica-

cious in stopping vomiting in cases of acute catarrh of the stomach in dogs, and is given as the wine with tincture of aconite, one drop each in a drachm of ice water, at half hour intervals. The drug is also of service in reflex vomiting, and that due to an atonic or depressed condition of the stomach. Therapeutically, ipecac should only be of value in the latter disorder, but it nevertheless is often efficient in the vomiting of irritable dyspepsia, as noted above.

2. Ipecac is prescribed in the first stage of acute bronchitis, when the secretion is scanty, and again in bronchitis of long standing, to stimulate the bronchial mucous membrane. It may be given to dogs and cats in repeated expectorant doses of the wine or syrup, with other expectorants, diaphoretics and diuretics, as syrup of squill and spirit of nitrous ether, or as Dover's powder, to all animals.

3. Ipecac is a feeble diaphoretic, and inferior to sweet spirit of nitre, aconite, alcohol or external heat, for general sudorific purposes. The combination of opium and ipecac, in Dover's powder, is an appropriate mixture to relieve pain and cause diaphoresis in acute rheumatism, and may cut short attacks of acute inflammation of the respiratory tract.

4. Ipecac is probably the best single remedy for the treatment of dysentery. It should be given in the form of powder, bolus, or pill every four hours, combined with opium to prevent nausea or vomiting. Extemporaneous decoctions are likewise useful given in the form of enemata, and may take the place of the drug by the mouth in dysentery or chronic diarrhea.

SECTION VIII.—ANTIPYRETIC AND ANTISEPTIC ORGANIC AGENTS.

Class 1.—Cinchona and its Alkaloids.

CINCHONA. Cinchona. (U. S. P.)

Synonym.—Cinchonæ cortex, B. P.; cortex chinæ, E.; quinquina, Fr.; chinarinde, G.

The dried bark of Cinchona Ledgeriana Moens, Cinchona calisaya Weddell, Cinchona officialis Linné, and of hybrids of these and of other species of cinchona (nat. ord. Rubiaceæ), yielding when assayed not less than 5 per cent. of total anhydrous cinchona alkaloids, and at least 5 per cent. of ether-soluble alkaloids.

Habitat.—Indigenous in South America on the east slope of the Andes, and northwards into Colombia; southwards to the lower part of Bolivia, at altitudes varying from 5,000 to 10,000 ft. Cultivated in India, East Indies, Jamaica, and to some extent in South America.

Description.—In quills or incurved pieces, varying in length, and usually 2 or 3 or sometimes 5 Mm. thick. The outer surface covered with a gray or brownish-gray cork, usually slightly wrinkled, marked with transverse, and also with intersecting, longitudinal fissures (C. Calisaya), and sometimes with scattered warts and slight, longitudinal ridges; inner surface light cinnamon-brown, very finely striate; fracture short and granular in the outer layer, and finely fibrous in the inner layer; powder, light brown or yellowish-brown; odor slight, somewhat aromatic; taste bitter and somewhat astringent.

Constituents.—(*a*) *Four chief alkaloids and three artificial products.*

* Isomers {
(1) *Quinine* ($C_{20}H_{24}N_2O_2 + 3\,H_2O$). Solutions of its salts are fluorescent. Turns plane of polarization to left. Gives green color with ammonia and chlorine water. Precipitated from its salts as hydrate.
(2) *Quinidine* ($C_{20}H_{24}N_2O_2$). Solutions of its salts fluorescent. Differs from quinine in turning plane of polarization to right, and in being insoluble in ammonia except in excess.

(Quinicine is an artificial amorphous alkaloid, probably not occurring naturally, and obtained from quinine by heat and excess of a mineral acid. Quinoidine is a cheap brown amorphous substance obtained from the mother liquor after quinine sulphate has crystallized out, and contains a mixture of quinidine, cinchonine and cinchonidine.)

* Isomers {
(3) *Cinchonine* ($C_{19}H_{22}N_2O$). Is not fluorescent. Turns plane of polarization to right. Does not assume a green color with ammonia or chlorine water.
(4) Cinchonidine ($C_{19}H_{22}N_2O$) is slightly fluorescent. Turns plane of polarization to left.

Cinchonicine is an artificial alkaloid obtained from cinchonine by heat and an excess of a mineral acid.

Some other alkaloids of no particular importance are:

Quinamina ($C_{19}H_{24}N_2O_2$).
Paricina ($C_{16}H_{18}N_2O$).
Aricina, etc.

* Isomers are bodies composed of the same elements, in the same proportions, but possessing different chemical or physical properties.

(*b*) *Less Important Constituents.*—(5) Kinic, or quinic acid ($C_7H_{12}O_6$), occurs in colorless prisms. Related to benzoic acid and eliminated in the urine as hippuric acid. Found in coffee beans and other vegetables.

The alkaloids in cinchona are naturally united with kinic or kinovic acid, and salts of this combination are used in medicine; *i.e.*, quinine kinate, which is soluble and may be employed subcutaneously.

(6) Kinovic, or quinovic acid ($C_{32}H_{48}O_6$), a white, amorphous substance allied to kinovin.

(7) Kinovin, or quinovin ($C_{30}H_{48}O_8$), a glucoside readily decomposed into glucose and kinovic acid.

(8) Cincho-tannic acid, or kino-tannic and kinovi-tannic acid (2-4 per cent.). The astringent principle of cinchona. Distinguished from tannic acid in yielding green color with ferric salts.

(9) Cinchona red, the coloring matter of cinchona bark. Nearly insoluble in water.

(10) A volatile oil existing in minute amount.

(11) Starch, gum, resin and salts common to other vegetable matters.

Incompatibility.—Cinchona is incompatible with lime water, ammonia, metallic salts or gelatin.

Dose.—H., ʒ ii.-iv. (8.-15.); C., ℥ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-iv. (4.-15.); D. & C, gr. x.-ʒ i. (.6-4.).

PREPARATIONS.

Fluidextractum Cinchonæ. Fluidextract of Cinchona. (U. S. P.)

Made by maceration and percolation with glycerin, alcohol and water; evaporation of the last portion of the percolate, and addition of the residue to first portion, with enough water and alcohol so that it shall contain 4 per cent. of alkaloids. (U. S. P.)

Dose.—Same as cinchona.

Extractum Cinchonæ Liquidum. (B. P.)

Contains 5 per cent. of alkaloids.

Dose.—Same as cinchona.

Infusum Cinchonæ Acidum. (B. P.)

Dose.—H., Oi. (500.); D., ʒ ii.-iv. (8.-15.).

Tinctura Cinchonæ. Tincture of Cinchona. (U. S. & B. P.)

Made by maceration and percolation of cinchona, 200, with glycerin, 75; and alcohol and water a sufficient quantity to make 1000. 0.75 gm. alkaloids in 100 cc. of tincture. (U. S. P.)

Dose.—H., ℥ i.-ii. (30.-60.); D., ʒ ss.-ii. (2.-8.).

Cinchona Rubra. Red Cinchona.

Cinchonæ rubræ cortex, B. P. The bark of Cinchona succirubra Pavon (nat. ord. Rubiaceæ), containing not less than 5 per cent. of anhydrous cinchona alkaloids.

Habitat.—Ecuador, west of Chimborazo.

Description.—In quills or incurved pieces, varying in length, and from 2 to 4 or 5 Mm. thick; the outer surface covered with a grayish-brown cork, more or less rough from warts and longitudinal, watery ridges, and from few, mostly short, transverse fissures; inner surface more or less deep reddish-brown and distinctly striate; fracture short-fibrous in the inner layer; powder reddish-brown; odor slight; taste bitter and astringent.

Constituents.—Same as cinchona.

Dose.—Same as cinchona.

PREPARATION.

Tinctura Cinchonæ Compositus. Compound Tincture of Cinchona. (U. S. & B. P.)

Made by maceration and percolation of red cinchona, 100; bitter orange peel, 80; serpentaria, 20; with glycerin, 75; and alcohol and water to make 1000. (U. S. P.)

Dose.—H., ʒ ii.-iv. (60.-120.); D., 3 ss.-iv. (2.-15.).

*Quininæ Sulphas. Quinine Sulphate.

$(C_{20}H_{24}N_2O_2)_2\ H_2SO_4 + 7\ H_2O$. (U. S. & B. P.)

Synonym.—Chininum sulfuricum, P. G.; sulfas quinicus, disulphate or basic sulphate of quinia, E.; sulphate de quinine, Fr.; schwefelsaures chinin, G.

Derivation.—Prepared by boiling cinchona bark with hydrochloric acid and adding lime to the filtered decoction to precipitate alkaloids and coloring matter. The precipitate is washed and digested in boiling alcohol to dissolve quinine and cinchonine. The alcohol is distilled off and the residue dissolved in diluted sulphuric acid, boiled with animal charcoal, filtered, and quinine sulphate crystallizes, leaving cinchonine sulphate in solution.

Properties.—White, silky, light and fine needle-shaped crystals; fragile and somewhat flexible, making a very light and easily compressible mass; lustreless from superficial efflorescence after being for some time exposed to the air; odorless, and having a persistent and very bitter taste. The salt is liable to lose water on exposure to

* *Tinc. Quininæ Ammoniata* (B. P.), from the sulphate. *Dose*—H., ʒ ss.-i. D., 3 ss.-i.

warm air, to absorb moisture in damp air, and to become colored by exposure to light. Soluble at 25° C. (77° F.), in 720 parts of water, and in 86 parts of alcohol; also in 36 parts of glycerin; in about 400 parts of chloroform; in 30 parts of boiling water; and freely in dilute acids.

Incompatibles.—Alkalies and their carbonates, iodine, and tannic acid.

Dose.—H. (tonic), gr. xv.-3 i. (1.-4.); C., 3 ss.-i.ss. (2.-6.); Sh. & Sw., gr. v.-x. (.3-.6); D. & Cats, gr. i.-ii. (.06-.12). Antipyretic Dose—H. & C., 3 ii.-iv. (8.-15.); Sh., gr. xxx.-xl. (2.-2.6); Sw., gr. xv.-xxv. (1.-1.6); D. & Cats, gr. v.-x. (.3-.6).

QUININÆ BISULPHAS. Quinine Bisulphate. $C_{20}H_{24}N_2O_2$ $H_2SO_4 + 7\ H_2O$. (U. S. & B. P.)

Derivation.—Made by the action of sulphuric acid on quinine sulphate suspended in water; filtration and crystallization.

Properties.—Colorless, transparent or whitish, orthorhombic crystals or small needles; odorless, and having a very bitter taste; efflorescing on exposure to the air; soluble in 8.5 parts of water and in 18 parts of alcohol; very soluble in boiling water and in boiling alcohol.

Dose.—Practically same as quinine sulphate, but theoretically it should be slightly larger. The salt is very soluble, but is commonly made extemporaneously by adding diluted sulphuric acid (Q. S.) to quinine sulphate in preparing solutions for medicinal use. The salt is serviceable for administration in pill; or for hypodermic injection, when it should be given in about one-third smaller dose than that of quinine sulphate by the mouth.

QUININÆ HYDROBROMIDUM. Quinine Hydrobromide. $C_{20}H_{24}N_2O_2\ H\ Br + H_2O$. (U. S. P.)

Derivation.—Made by the action of barium bromide, in solution, on quinine sulphate suspended in water; filtration, evaporation, and crystallization.

Properties.—White, light, silky needles; odorless, and having a very bitter taste. The salt is likely to lose water on exposure to warm or dry air. Soluble in 40 parts of cold water, and in 0.67 part of alcohol; very soluble in boiling water and boiling alcohol; also soluble in 16 parts of ether and very soluble in chloroform (77° F.).

Dose.—Same as quinine sulphate.

*Quininæ Hydrochloridum. Quinine Hydrochloride.
$C_{20}H_{24}N_2O_2$ H Cl + 2 H_2O. (U. S. & B. P.)

Derivation.—Made by the action of hydrochloric acid on quinine, and by crystallization.

Properties.—White, silky, light and fine, needle-shaped crystals; odorless, and having a very bitter taste. The salt is liable to lose water when exposed to warm air. Soluble in 18 parts of water, and in 0.6 part of alcohol; in 1 part of boiling water, and very soluble in boiling alcohol; also soluble in 0.8 part of chloroform (77° F.).

Dose.—Same as quinine sulphate.†

Quininæ Valeras. Quinine Valerate.
$C_{20}H_{24}N_2O_2C_5H_{10}O_2 + H_2O$. (B. P.)

Derivation.—Made by decomposition of quinine sulphate with ammonia, followed by the immediate action of valerianic acid, and crystallization from a cold solution.

Properties.—White, or nearly white, pearly, lustrous, triclinic crystals, having a slight odor of valerianic acid, and a bitter taste. Permanent in the air. Soluble in 100 parts of cold water, and in 5 parts of alcohol; in 40 parts of boiling water, and in 1 part of alcohol.

Dose.—D., gr. i.-ii. (.06-.12). Three times daily as tonic.

Quininæ et Ureæ Hydrochloridum. Quinine and Urea Hydrochloride. (Non-Official.)

Synonym.—Quininæ Bimuriatis carbamas. Quinine and urea bimuriate.

Prepared by dissolving quinine hydrochloride, 400, in dilute HCl, 300; mixing with 60 to 61 parts of urea $CO(NH_2)_2$; warming, filtering and allowing to crystallize. Occurs in large, transparent prisms, or in hard, white, interlaced, four-sided prisms. Soluble at ordinary temperatures in its own weight of water, and in alcohol.

Chinoidinum or Quinoidinum. Chinoidine or Quinoidine.

Brown, resinous mass, containing mixture of quinidine, cinchonine and cinchonidine. A cheap substitute for quinine sulphate.

Dose.—Three or four times that of quinine sulphate.

* *Tinctura Quininæ* (B. P.), from the hydrochloride. *Dose*—H., ʒ ss.-i. D., 3 ss.-i.

† *Quininæ Salicylas*, Quinine Salicylate (U. S. P.). Soluble in 77 parts of water. Occurs in colorless needles. Dose as for sulphate.

QUINIDINÆ SULPHAS. Quinidine Sulphate. $(C_{20}H_{24}N_2O_2)_2$. $H_2SO_4 + 2\ H_2O$. (Non-Official.)

The neutral sulphate of an alkaloid obtained from the bark of several species of cinchona (nat. ord. Rubiaceæ).

Synonym.—Sulfate de quinidine, Fr.; schwefelsaures chinidin (cinchinin), G.

Derivation.—Recovered from quinoidine, or from the mother liquors after the crystallization of quinine sulphate, by the same method as for quinine.

Properties.—White, silky needles, odorless, and having a very bitter taste; permanent in the air. Soluble in 100 parts of cold water, and in 8 parts of alcohol; in 7 parts of boiling water, and very soluble in boiling alcohol; also in 14 parts of chloroform and in acidulated water; almost insoluble in ether.

Dose.—One-third larger than quinine sulphate.

CINCHONINÆ SULPHAS. Cinchonine Sulphate. $(C_{19}H_{22}N_2O)_2$. $H_2SO_4 + 2\ H_2O$. (U. S. P.)

Derivation.—Obtained from the mother liquors after the crystallization of the sulphates of quinine, quinidine and cinchonidine, by precipitation with caustic soda, washing with alcohol to free it from other alkaloids, solution in sulphuric acid, and by purification with animal charcoal, and crystallization.

Properties.—Hard, white, lustrous, prismatic crystals, without odor, and having a very bitter taste. Permanent in the air. Soluble in 58 parts of cold water, and in 10 parts of alcohol; in 13.59 parts of boiling water, and in 3.25 parts of boiling alcohol. Also soluble in 78 parts of chloroform, but almost insoluble in ether.

Dose.—One third larger than that of quinine sulphate.

CINCHONIDINÆ SULPHAS. Cinchonidine Sulphate.* $(C_{19}H_{22}N_2O)_2\ H_4SO_2 + 3\ H_2O$. (U. S. P.)

Derivation.—Procured from the mother liquors, after the crystallization of quinine sulphate, by further concentration. Purified by crystallization from alcohol, and finally from hot water.

Properties.—White, silky, acicular crystals, without odor, and having a very bitter taste; slightly efflorescent on exposure to air. Soluble in 63 parts of water, and in 72 parts of alcohol; in 1.42

* *Elixir Ferri, Quininæ et Strychninæ Phosphatum* (U. S. P.), and *Syrupus Ferri Phosphatis cum Quinina et Strychnina* (B. P.), (dose—D., 3 i.), are good tonic preparations for dogs.

parts of boiling water, and in 8 parts of boiling alcohol; also soluble in 900 parts of chloroform, and almost insoluble in ether.

Dose.—One-third larger than that of quinine sulphate.

CINCHONA AND ITS ALKALOIDS AS REPRESENTED BY QUININE.

Action External.—The action of quinine on all forms of protoplasm is to stimulate in small doses, or in much dilution, and to depress and paralyze in large doses, or in strong solutions. It has the same action on unorganized living matter (ferments) in many cases but does not affect some. It is still more destructive to protozoa, especially to the organisms of malaria and Texas fever. Quinine is a powerful antiseptic and microbicide. A solution (1 to 250) of the alkaloid or its salts are poisonous to the microbes of fermentation and putrefaction. A one per cent. solution quickly destroys bacteria and vibrios, but spores may live in it for some days. Quinine and its salts cause irritation of the denuded skin, or mucous membranes, but exert no effect upon the unbroken skin.

Action Internal.—Digestive Tract.—Quinine, in therapeutic doses, acts as a simple bitter (stomachic), and therefore promotes appetite and gastric digestion. It stimulates the gustatory nerves in the mouth and gastric nerves in the stomach, thus reflexly increasing the flow of saliva and gastric juice, and the vascularity and peristaltic motion of the stomach together with the appetite. Experimentally, quinine increases the activity of the ferments of the gastric and pancreatic juices (pepsin, rennin, trypsin) in great dilution while destroying them in larger amounts. Large doses, particularly if the stomach be irritable, may cause vomiting. Quinine becomes dissolved in the gastric juice and is converted into the chloride. A portion unabsorbed finds its way into the bowels and is there precipitated by the alkaline juices and bile, whose acids form insoluble salts with quinine, unless the bile is in great excess.

Blood.—Quinine is absorbed into the blood, and would naturally be precipitated in this alkaline fluid; but this is not the case, and it has been shown that quinine is probably held in solution by the loosely combined carbonic dioxide gas in the blood. Quinine possesses several well-defined and important actions in relation to the blood.

1. *White Blood Corpuscles.*—Quinine in great dilution lessens the ameboid movements of the white corpuscles in blood removed from the body. When a frog receives large doses of quinine and its mesentery is irritated, the white corpuscles do not collect in the arterioles or migrate through their walls (diapedesis). Again, when inflammation has already begun in the mesentery, quinine stops the

transmigration of leucocytes, and yet does not stop those in the tissues from wandering away. Moreover, large doses markedly lessen the number of white corpuscles in the blood. While medicinal doses of quinine given by the mouth unquestionably produce leukopenia, yet it is generally considered highly improbable that the effect of quinine in inhibiting the movement of leucocytes observed in the frog, when large doses are introduced into the blood, occurs after the therapeutic use of the drug in mammals. Yet it has recently been shown that a solution of quinine in blood, equal to that when a full dose (gr. x., man) is ingested, increases markedly phagocytosis in the case of all the common pathogenic organisms. Very large doses (gr. xxx.-xl., man) diminish phagocytosis. It is hard to explain this action when we consider leucocytosis is hindered by quinine, but it may show why benefit should be expected from the drug in septic conditions.

2. *Red Blood Corpuscles.*—Therapeutic doses increase the number of red corpuscles. The latter diminish in size in febrile conditions, but, under the action of quinine (and other antipyretic agencies), regain their normal condition. This follows the effect of quinine in lowering temperature, and is not due to any specific power of quinine exerted on the corpuscles themselves.

Heart and Blood Vessels.—Quinine in moderate doses does not affect the heart or vessels appreciably. Large doses at first stimulate the muscle of the heart and blood vessels and cause the pulse to be accelerated and vascular tension to be raised. In poisoning this effect is temporary and is followed by depression of the muscle of the vessel walls and heart and the cardiac pulsations become slow and weak and the blood tension falls. Death occurs immediately from failure of respiration. Although the heart is much weakened it commonly continues to beat for some time after breathing ceases. The action on the heart is like that on all forms of living tissues—primary stimulation followed by depression and paralysis.

Nervous System.—Here again the general action consists in primary stimulation followed by depression and paralysis of the cerebrospinal system. The breathing is first accelerated and then weakened and death occurs from paralysis of the respiratory centre. Fatal poisoning is very rare after ingestion of quinine. Ounce doses have been swallowed by man without serious result. Occasionally convulsions have occurred but perhaps due to an admixture of the other alkaloids, as cinchonidine and cinchonine are convulsive agents in toxic doses. Toxic doses of quinine injected into the carotid artery cause meningitis by direct irritation. In man, ringing in the ears, fulness in the head, and slight deafness commonly follow a large medicinal dose (cinchonism). Blindness also very rarely occurs in man after large doses. Vomiting, diarrhea, albuminuria and

skin eruptions sometimes occur in poisoning by the drug due to local irritation. There are contraction of the retinal vessels and degenerative changes in the retina and spiral ganglia of the cochlea, which account for the loss of sight and hearing. There is some clinical evidence that quinine in medicinal doses is a cerebral stimulant, but there is no experimental proof of the fact.

Spinal Cord and Nerves.—Quinine, as shown by experiments conducted on the frog, lessens reflex activity after small doses. This condition disappears on section of the medulla. Toxic doses, however, cause permanent loss of reflex excitability. The same alkaloid first excites and then paralyzes the peripheral sensory nerve endings. These effects on the nervous system are not observed in mammals. Muscular contractility is stimulated by small and paralyzed by poisonous doses of quinine.

Uterus.—In experiments with the intravenous or subcutaneous injection of quinine into animals normal uterine contractions are augmented or rhythmical contractions are originated by the drug. The production of labor pains or abortion has been observed in woman following the use of large doses for the cure of malaria. The alkaloid stimulates uterine contractions in inertia of parturition but there is considerable testimony affirming that it increases at the same time the tendency to flowing.

Kidneys, Metabolism and Elimination.—Quinine lessens the elimination of both urea and uric acid. It is therefore evident that there is some alteration or inhibition of metabolism whereby nitrogenous decomposition is decreased and nitrogen is stored in the body. There is no diminished oxidation of carbohydrates in the tissues, which is the chief source of animal heat, for the excretion of CO_2 and absorption of O by the lungs is unaltered by quinine. This accords with the known fact that the oxidizing ferment of the tissues is inhibited by the drug. About three-fourths of the quinine absorbed is destroyed in the tissues. The remaining fourth escapes unchanged in the urine in man but much altered in dogs. While its excretion in the urine begins soon after its ingestion, and lasts for some days, the greater amount escapes within twenty-four hours. None is found in the other excretions.

Antipyretic Action.—Quinine does not alter the normal temperature of a healthy animal, but does reduce temperature in fever. The amount of reduction depends upon the cause of the fever. An explanation of the antipyretic power of the alkaloid may include:

1. The antiseptic property of quinine. This is most marked in the case of the plasmodium malariæ, which is destroyed by the alkaloid, and the malarial fever is therefore overcome.

2. By retarding nitrogenous decomposition or metabolism and thus lessening the production of heat in the tissues.

3. By dilating the vessels of the skin and therefore inducing loss of heat.

Administration.—Quinine sulphate is usually given to horses in aqueous solution with sufficient diluted sulphuric acid to dissolve the salt. It may also be administered to these animals in ball, gelatine capsule, enema or subcutaneously. Quinine is exhibited to dogs in pills, solution or suppositories. The alkaloid is not commonly injected under the skin, because local irritation and abscess may follow; but this does not frequently happen in the horse. The bisulphate, hydrobromide and hydrochloride are most suitable for hypodermic use. The first salt is more soluble, but the latter two are less irritating.

At a temperature of 45° C. (113° F.)

Quinine bisulphate is soluble in	8.8	parts of water.
Quinine hydrobromide is soluble in	45.02	" " "
Quinine hydrochloride is soluble in	21.4	" " "

This temperature may be used for subcutaneous injection, but the salts should be thoroughly dissolved and one grain of tartaric acid should be added to each five grains of quinine bisulphate, in order that precipitation may not occur in the tissues. The dose by the subcutaneous method is one-third less than by the mouth.

The sulphates of quinidine, cinchonine and cinchonidine are similar in action to quinine, and their relative antipyretic effect is said to be: quinine, 100; quinidine, 90; cinchonidine, 70; cinchonine, 40. The cinchona compounds are indicated for tonic and stomachic purposes.

Uses External.—Quinine and urea hydrochloride has recently come into extensive use as a local anesthetic. In 1 per cent. solution it forms a satisfactory substitute for cocaine and its allies and it has three advantages over cocaine. It is non-toxic, it may be boiled in solution, and its anesthetic effect is often prolonged for hours or days, lessening pain and spasm after operation and aiding dressing of wounds. Anesthesia comes on within 5 to 30 minutes after injection into the tissues. In 25 per cent. solution it is used to anesthetize mucous membrane, but is not so satisfactory as cocaine for this purpose. It has been used in a great variety of operations, including those within the belly. The line of incision on the belly wall is anesthetized and after the belly is opened the parietal peritoneum must be injected. Not much pain is caused by handling the viscera unless the mesenteric attachments are pulled upon.

Uses Internal.—It is impossible to draw definite deductions as to the therapeutic indications for quinine founded on physiological experiments, since these are only suggestive and not conclusive. For the sake of convenience, we may classify the uses of quinine under the following heads:

1. *Tonic Action.*—Quinine is of unquestionable value as a tonic, more particularly in relation to digestion, but probably also by increasing the number of red corpuscles and stimulating the nervous system generally. It is in those cases of anorexia and atonic dyspepsia secondary to exhaustion, overwork, anemia, or following acute diseases, that the drug is indicated. Here, combination with iron is often of service, and the tincture of the chloride is a good preparation because it contains sufficient free muriatic acid to dissolve any of the salts of quinine. The compound tincture of cinchona is a prime, bitter tonic for dogs; or quinine may be given in a pill with reduced iron and arsenic as a tonic. Chorea in the human patient has been treated successfully with quinine, but this remedy has failed in dogs. Nevertheless, the alkaloid is an excellent tonic in canine distemper with its accompanying anemia, but it should be combined with iron and arsenic. Quinine is a good tonic for purpura in horses.

2. *Antiseptic and Antiphlogistic Effect.*—Quinine possesses much less antipyretic power than phenacetin, antipyrin and acetanilid. It acts more favorably with a falling than a rising temperature, and should be given two or three hours before the probable time of maximum temperature. Quinine is employed in many acute diseases, such as influenza, bronchitis and pneumonia of horses. In full doses, at the outset of colds or inflammatory diseases of the respiratory tract, quinine may prove abortifacient. Later in these diseases the drug may be given as an antipyretic and antiphlogistic (without much benefit probably), but in the convalescent stages quinine, in small doses, becomes of great worth as a tonic. Some experiments involving the injection of putrid material into the blood of dogs, appeared to indicate that quinine had a restraining influence on the resulting septic state, and, in some cases, saved life.

Puerperal fever and erysipelatous inflammation yield somewhat to quinine, and the drug should be tried in these infections. The alkaloid does not lower the temperature or prove destructive to the micrococci of pyemia. A vast number of cases of rheumatic fever have been treated with quinine in human practice, but the results are inferior to those obtained by salicylates. In subacute and chronic muscular rheumatism quinine is sometimes useful. It has been injected into the affected muscles in this disorder, in horses, with favorable results.

The alkaloids of cinchona may be used as antipyretics in all acute diseases with the exception of meningitis, cerebritis, gastritis, nephritis and cystitis, where they produce too much irritation. They are also contra-indicated in epilepsy and middle-ear disease.

3. *Specific Properties.*—One c.c. of a 1 per cent. solution of bimuriate of quinine and urea to the pound, live weight, has recently been found by Mark Francis (Texas Exper. Sta., 1911) to prove curative in 98 per cent. of cases of Texas fever in cattle when not seen too late. The warm sterile solution is injected within the abdominal cavity in the standing animal. The point of injection is in the right flank low down in front of the anterior border of the internal oblique muscle.

It is done by allowing the fluid to run in by gravity from a 1000 c.c. wash flask of the laboratory connected with 3 ft. of sterile tubing and needle. The fluid should flow freely or else the needle is not in the abdominal cavity. The skin should be first shaved and scrubbed and sterilized with alcohol or, better, iodine or Harrington's solution. One injection is usually sufficient, but it may be repeated in 48 hours if necessary. Quinine stands preëminent in the treatment of malaria, as it is the only drug which can be relied upon to kill malarial organisms. While periodicity in the febrile attacks is characteristic of malaria, an absolute diagnosis can only be made by the discovery of Laveran's plasmodium in the red blood corpuscles. Malaria but rarely affects the lower animals in this country, although exceedingly common among human beings. Cases are said to occur not infrequently among horses and cattle in India. A single full antipyretic dose of quinine, if given from twelve to six hours before a promised malarial attack, will usually prevent it. A single large dose should be given once daily for several days thereafter. When the disease is severe, treatment may also be pursued by the rectal and hypodermic methods at the same time that quinine is given by the mouth. A purge of aloes and calomel should be exhibited prior to the administration of quinine in the treatment of malaria.

Class 2.—Salicylic Acid, Salicin, Salol, Oil of Gaultheria and Methyl Salicylate.

ACIDUM SALICYLICUM. Salicylic Acid. $HC_7H_5O_3$.
(U. S. & B. P.)

Synonym.—Acid salicylique, Fr.; salicylsaüre, G.

An organic acid, existing naturally in combination in various plants, but chiefly prepared synthetically from carbolic acid.

Derivation.—Made by passing carbonic dioxide through sodium carbolate at a temperature of 428° F. (220° C.). $2\ NaC_6H_5O$ (sodium carbolate) $+\ CO_2 = Na_2C_7H_4O_3$ (sodium salicylate) $+$ C_6H_6O (phenol). Sodium salicylate is treated with hydrochloric acid, when salicylic acid is precipitated. $Na_2C_7H_4O_3 + 2\ H\ Cl =$ $HC_7H_5O_3 + 2\ Na\ Cl$.

Properties.—Light, fine, white, prismatic needles, or a light, white, crystalline powder; odorless, having a sweetish, afterward acrid taste, and permanent in the air. Soluble in about 308 parts of water, and in 2 parts of alcohol; in 14 parts of boiling water, and very soluble in boiling alcohol. Also soluble in ether, absolute alcohol, and chloroform.

Incompatible.—Spirit of nitrous ether.

Impurities.—In artificial salicylic acid, metacreosotic and orthocreosotic acids.

Dose.—H. & C., ʒ ii.-ʒ i. (8.-30.); Sh., ʒ i.-iv. (4.-15.); Sw., ʒ ss.-i. (2.4.); D., gr. v.-xxx. (3.-2.).

PREPARATION.—*Unguentum Acidi Salicylici* (2 per cent.), B. P.

SALICINUM. Salicin. $C_{13}H_{18}O_7$. (U. S. & B. P.)

A neutral principle (glucoside) obtained from several species of Salix and Populus (nat. ord. Salicaceæ).

Habitat.—Europe, but cultivated in North America.

Derivation.—Obtained from a decoction of willow bark. Salicin crystallizes on evaporation, after removal of tannin by agitation with lead oxide. It is purified by repeated solution and crystallization.

Properties.—Colorless, or white, silky, shining crystalline needles, or a crystalline powder; odorless, and having a very bitter taste. Permanent in the air. Soluble in 21 parts of water, and in 71 parts of alcohol; insoluble in ether or chloroform.

Dose.—H. & C., ʒ ii.-ʒ i. (8.-30.); Sh., ʒ i.-iv. (4.-15.); Sw., ʒ ss.-i (2.-4.); D., gr. v.-xxx. (.3-2.).

*SODII SALICYLAS. Sodium Salicylas. $NaC_7H_5O_3$. (U. S. & B. P.)

Synonym.—Silicylate de soude, Fr.; natrium salicylicum, G.

Derivation.—Made by the action of salicylic acid on sodium

* Strontii salicylas and lithii salicylas are now official. Strontium salicylate is less irritating to the stomach and lithium salicylate combines action of lithium salts. Doses same for both as for the sodium salt.

carbonate. 2 $HC_7H_5O_3 + Na_2CO_3 = 2$ $NaC_7H_5O_3 + H_2O + CO_2$. The solution is filtered, and heated to expel carbon dioxide.

Properties.—A white, amorphous, microcrystalline powder or scales; odorless, and having a sweetish, saline taste. Permanent in cool air. Soluble in 0.8 part of water, and in 5.5 parts of alcohol; very soluble in boiling water or alcohol; also soluble in glycerin.

Dose.—Same as salicin.

Phenylis Salicylas. Phenyl Salicylate, $C_{13}H_{10}O_3$. (U. S. P.)

Synonym.—Salol, B. P.; salicylic ether of phenol.

Derivation.—Made by heating salicylic and carbolic acids with phosphorous pentachloride.

Properties.—A white, crystalline powder; odorless, or having a faintly aromatic odor, and almost tasteless. Permanent in the air. Almost insoluble in water; soluble in 5 parts of alcohol; also soluble in 0.3 part of ether, and readily in chloroform, and in fixed or volatile oils.

Dose.—H., 3 iii.-vi. (12.-24.); D., gr. v.-x. (0.3-0.6).

SALICYLIC ACID, SALICIN, SODIUM SALICYLATE AND PHENYL SALICYLATE OR SALOL.

Action External.—Salicylic acid, sodium salicylate, salicin and salol are powerful antiseptics resembling carbolic acid in action but less toxic and irritant. A solution of salicylic acid (1-60) is equivalent to a solution of carbolic acid (1-22) in destroying some bacteria, but is not generally as useful, being less penetrating in its action on the tissues. In solution salicylic acid softens and removes the horny layer of the skin without causing any soreness. Salicylic acid, sodium salicylate and salicin, in their pure state, are irritating to the unbroken skin or raw surfaces. Salol is not.

Action Internal.—Salicylic acid is an irritant in the digestive tract and in large doses causes nausea and vomiting in dogs. It slightly increases the flow of bile. Salicylic acid is converted into salicylates by the alkaline intestinal juices, and is absorbed in this form, chiefly as sodium salicylate. For this reason, and because the latter salt is less irritating than salicylic acid, sodium salicylate is preferred to the acid when a constitutional action is desired. Salicin splits up in the bowels into salicylic acid, salicylous acid ($HC_7H_5O_2$), salicyluric acid ($HC_9H_8NO_4$), and glucose. Salol is decomposed by the pancreatic juice into salicylic acid (64 per cent.) and carbolic acid (36 per cent.) After large doses the urine takes on the char-

acteristic smoky color produced in poisoning by phenol. Salol is an intestinal antiseptic. The salicylic group are slight cholagogues.

Circulation.—Moderate doses of sodium salicylic, or salicylic acid increase blood pressure by stimulation of the heart muscle and vaso-constrictor centre, but large doses depress the heart force, blood pressure and nervous system. The artificial acid is said to be more depressant than natural salicylic acid obtained from plants, because of orthocreosotic and metacreosotic acids existing as impurities in the former. Natural salicylates cost 5 to 10 times as much as the artificial, and Eggleston, from an exhaustive recent study, states that there is no material difference in the action of the two.

Nervous System.—The only known action of salicylic acid on the central nervous system is that on the medullary, respiratory and vasomotor centres which are first stimulated, then depressed, and finally paralyzed by lethal doses.

Therapeutic quantities often cause, in man (salicylism), ringing in the ears and headache. Besides, some deafness, dimness of vision and excessive perspiration are not uncommon after large doses.

Respiration.—The respiratory movements are primarily quickened by the stimulation of the peripheral vagi and respiratory centres produced by sodium salicylate and salicylic acid; but after large doses the respiratory centres are depressed and paralyzed and death takes place by asphyxia.

Temperature.—Medicinal doses do not influence the normal temperature of healthy animals, but do often lower bodily heat in fever, and frequently induce sweating. The largest therapeutic doses must be given to secure an antipyretic action. Antipyresis occurs from heat loss due to dilation of cutaneous blood vessels.

Kidneys and Elimination.—Salicylic acid, salicin and sodium salicylate circulate in the blood as sodium salicylate and are eliminated in the urine as salicyluric and salicylic acids. This happens in this wise: Some of the salicylic acid of sodium salicylate combines with glycocoll in the body and forms salicyluric acid. $HC_7H_5O_3 + C_2H_5NO_2$ (glycocoll) $= HC_9H_8NO_4$ (salicyluric acid) $+ H_2O$; while some of the sodium salt is decomposed by phosphoric acid in an acid urine into salicylic acid. Like quinine, the excretion of salicylic acid begins soon, in one hour, and is all excreted within 48 hours. Therefore large doses given continuously accumulate in the body, and it is said the salicylates thus accumulate chiefly in the synovial fluid in the various joint cavities which accounts for their action in rheumatism. The quantity of urea and uric acid in the urine is increased very considerably by salicylic acid, and usually the amount of urine itself. It is made aseptic by the escaping salicylic acid, or in the case of salol, by both carbolic and salicylic

acids. Sometimes salicylates irritate the kidneys in large doses and blood and albumin appear in the urine. The urine of animals taking salicylic acid may be rendered green by indican and pyrocatechin, formed through the action of pancreatic juice, and takes on a purple color with ferric chloride. Salicylic acid is also eliminated in the milk, sweat and bile.

Toxicology.—In man, continued large doses give rise to delirium, vomiting, depression of the circulation, epistaxis, hematuria, and retinal hemorrhages. The herbivora are not easily affected by large doses of salicylic acid or salicylates, but dogs exhibit nausea and vomiting, accelerated respiration, irregular pulse, loss of muscular strength, staggering gait, stupor, and, if death occurs, it is preceded by slow breathing, dilated pupils, dyspnea, and convulsions due to asphyxia. The minimum fatal dose for a small dog is about one drachm of sodium salicylate, subcutaneously.

Administration.—Sodium salicylate contains 48 grains of the acid to the drachm. Sodium salicylate is used in preference to the acid because it is soluble and unirritating. It is given in solution, or to dogs in pills or tablets. Salicylic acid may be exhibited in solution by warming it with glycerin (gr. iv.-ʒ i.); or with syrup (1-5), and aqua ammoniae in sufficient quantity to dissolve it, thus forming ammonium salicylate. It may also be administered in pill or ball. Salol is given in pill, powder or mixture with water. The larger doses of salicylic acid and salicylates should not be repeated, and are used for their antipyretic action. A maximum daily dose of one ounce of salicylic acid or sodium salicylate, for horses, or one drachm of either for large dogs, should rarely be exceeded.

Uses External.—Salicylic acid is employed in various forms as an antiseptic. Aqueous solutions (1-300) may be applied to wounds. Stronger solutions are prepared with alcohol, borax, sodium bicarbonate, and ammonium acetate solution. Salicylic acid may be applied as a dusting powder with zinc oxide (1-8), or in ointment (1-20 or 30), for its stimulant and antiseptic effect on wounds. It is used in the treatment of burns with cottonseed oil (1-8). Salicylic acid is useful in powder or ointment in acute moist eczema (1-50), and in the following formula:

Salicylic acid, one part; zinc oxide, starch and vaseline, each 16 parts. Ringer recommends in pruritus ani and vulvæ—salicylic acid, ʒ ii.; ol. theobrom., ʒ v.; cetac., ʒ iii.; ol. myrist, ʒ i.-ss. Salicylic acid is of value in skin diseases with induration, and for removing horny growths as warts and corns. For the latter it is mixed with collodion (ʒ ii. in ℥ i.) and applied twice daily for a week or so when the growth comes away without any irritation.

Salol is used as an antiseptic dusting powder of uncertain value.

Uses Internal.—The salicylic acid group are specifics in rheumatic fever. They lower temperature, lessen pain, and by shortening the attack lessen the danger of cardiac complications. Sodium salicylate should be given every three hours in doses of 3 ii. to horses, and gr. x.-xx. to dogs. But this form of rheumatism is rare in veterinary practice, and salicylic acid is unfortunately not nearly so valuable in the treatment of other varieties. Salicylates are probably worthless in chronic rheumatic arthritis where the local application of heat, stimulating liniments and blisters are serviceable; but they may be used with benefit in acute muscular rheumatism, sciatica, and rheumatic complications of influenza in horses. Salicylic acid, salicin, and salicylates are not comparable with the cold tar products as general antipyretics, and are useless in hyperpyrexia. Sodium salicylate is sometimes prescribed in gastric fermentative dyspepsia when the salicylic acid, set free by the hydrochloric acid of the gastric juice, acts as an antiseptic. Salol is a good intestinal antiseptic in diarrhea and intestinal indigestion, particularly when combined with bismuth subnitrate in powder or aqueous mixture for dogs. Salol is undissolved in the stomach, is less irritating than either salicylic acid or sodium salicylate, and is prescribed to lessen pain and fever. It may be advantageously given in doses of gr. v. to dogs, with phenacetin gr. v., and codeine gr. ½, for painful rheumatism. It is probably inferior to sodium salicylate, but can be conveniently administered in powder as just noted. Salol is also a local anæsthetic and antiseptic in the urinary tract (carbolic acid from decomposition), and is useful in cystitis and urethritis, to alleviate pain, to prevent frequent micturition, and to render the urine asceptic. It may be combined advantageously for this purpose with hexamethylenamine. Salicin acts more slowly than salicylic acid or sodium salicylate, and is not in general use. Salicylates are used in indigestion with slight icterus in acting as cholagogues.

ASPIRIN. ACETYLSALICYLICUM. ACETYLSALICYLIC ACID.

$C_9H_8O_4$.

Aspirin is made by heating fifty parts of salicylic acid with seventy-five parts of acetic anhydride at a temperature of 302° F., and by purification and crystallization. It occurs in small colorless, crystalline needles, odorless and having an acidulous taste. It is soluble in 100 parts of water and freely soluble in alcohol and ether.

With alkalies it is decomposed into salicylic acid and salicylates with the liberation of acetic acid. It passes through the stomach unchanged and is slowly dissolved in the alkaline juices of the intes-

tines, with less systemic symptoms (tinnitus in man) than follows the use of salicylic acid. It is merely a substitute for the latter and is supposed to be less irritating to the stomach but this is not always the case. Fashion has at present endowed it with much wider scope than has been given to salicylates and salicylic acid. It is suitable in the same cases in which the latter are indicated, as in rheumatic affections and as an intestinal antiseptic. It is often combined with other antipyretics and analgesics, as acetphenetidin. It is incompatible with alkalies, their carbonates or bicarbonates.

Dose.—H., ʒ ii.-iv. (8.-15.); D., gr. v.-xx. (0.3-1.3). Given in capsules or tablets to dogs; with syrup to horses.

Oleum Gaultheriæ. Oil of Gaultheria. (U. S. P.)

Synonym.—Oil of checkerberry, oil of wintergreen, oil of boxberry.

A volatile oil distilled from the leaves of Gaultheria procumbens Linné (nat. ord. Ericaceæ), consisting almost entirely of methyl salicylate ($CH_3C_7H_5O_3$), and nearly identical with volatile oil of betula.

Habitat.—North America; west as far as Minnesota, and south to Georgia.

Properties.—A colorless or yellow, or occasionally reddish liquid, having a characteristic, strongly aromatic odor, and a sweetish, warm and aromatic taste. Spec. gr. 1.172 to 1.180 at 77° F. Solubility same as methyl salicylate.

Dose.—H., ʒ ii.-ʒ i. (8.-30.); D., ♏v.-xv. (.3-1.).

Oleum Betulae. Oil of Betula. (U. S. P.)

Synonym.—Oil of sweet birch. It is practically identical in properties and action with oil of gaultheria.

Methyl Salicylate. $CH_3C_7H_5O_3$. (U. S. P.)

Synonym.—Artificial or synthetic oil of wintergreen.

Derivation.—Prepared by distillation of salicylic acid or salicylates, with methyl alcohol and sulphuric acid.

Properties.—A colorless or slightly yellowish liquid, having the characteristic, strongly aromatic odor and the sweetish, warm and aromatic taste of oil of gaultheria, with the essential composition of which it is identical. It is wholly identical with oil of betula (birch).

Spec. gr. 1.180-1.185 at 77° F. Soluble in all proportions in alcohol, glacial acetic acid, or carbon disulphide.

Dose.—H., ʒ ii.-ʒ i. (8.-30.); D., ♏v.-xv. (.3-1.)

ACTION AND USES OF OIL OF GAULTHERIA, OIL OF BETULA AND METHYL SALICYLATE.

Oil of wintergreen contains about 90 per cent. of methyl salicylate. Eleven parts of methyl salicylate are equivalent to nearly ten parts of salicylic acid. The oil and methyl salicylate are free from the impurities of artificial salicylic acid, while methyl salicylate is of more certain composition than the oil. Both behave similarly to salicylic acid therapeutically, although the oil is more of a local irritant, and they are used for the same purposes as salicylic acid. Either may be given in emulsion, or to dogs in capsules, and in combination with salicylic acid or salicylates.

Methyl salicylate is serviceable in the following liniment for rheumatism:

℞

Tinc. opii.
Methyl Salicylatis.
Chloroformi .....āā ʒ i
Lin. Saponis.....ad. ʒ viii.

M.
S. External use.

The external application of methyl salicylate to acutely inflamed rheumatic joints is one of the most efficient forms of treatment, and, since some is absorbed, will take the place of the internal administration of salicylates to a slight extent. It is usually best to combine this treatment with internal medication, however. Plain gauze, or other absorbent material, is saturated with methyl salicylate, applied to the affected joint, and then covered with oil silk, or rubber protective and bandage.

SECTION IX.—VOLATILE OILS, OR DRUGS CONTAINING THEM.

GENERAL ACTION OF VOLATILE OILS.

Synonym.—Essential, ethereal, aromatic or distilled oils.

Externally, volatile oils cause reddening of the skin (rubefacients), sometimes blistering (vesicants), and often local anesthesia, notably oil of cloves and peppermint. They are also

parasiticide, antiseptic and disinfectant, penetrating into the protoplasm of bacteria. *Internally,* these agents stimulate the flow of gastric, salivary and intestinal secretions and increase the vascularity and movements of the stomach and bowels, and are antiseptic and anthelmintic. They therefore temporarily improve digestion, overcome flatulence by expelling gas from the intestines, prevent griping produced by cathartics, and disguise and offset disagreeable effects and tastes of medicines. In the digestive tract, volatile oils excite reflexly the nervous system and heart, and augment the pulse rate and vascular tension. In large doses, volatile oils are gastro-intestinal irritants. Volatile oils may be absorbed from the skin, bronchial mucous membrane, and stomach. They are eliminated by the skin, bronchial mucous membrane and kidneys, and act as antiseptics and parasiticides in the kidneys and lungs.

In the process of excretion the parts are stimulated; vascularity, secretion, and contractility of the unstriated muscle of the bronchial tubes are increased, and volatile oils thus assist expectoration and coughing. In irritating the kidneys and mucous membrane of the genito-urinary tract, the volatile oils are stimulant and diuretic; while in poisonous doses they produce acute nephritis, strangury, and hematuria. Toxic doses, injected into the circulation, lower the force of the heart and the blood pressure, and occasion a sort of intoxication, and sometimes convulsions. To summarize: volatile oils possess the following actions in a greater or less degree: parasiticide, antiseptic, disinfectant, rubefacient, vesicant, local anesthetic, sialagogue, stomachic, carminative, antispasmodic, stimulant, expectorant, emmenagogue, and diuretic actions.

Class 1.—Used Mainly for their Action on the Skin.

Terebinthina. Turpentine. (U. S. & B. P.)

A concrete oleoresin obtained from Pinus palustris Miller, and from other species of Pinus (nat. ord. Coniferæ).

Habitat.—Southeastern United States; from Virginia to the Gulf of Mexico.

Description.—In yellowish, opaque, tough masses, brittle in the cold; crumbly, crystalline in the interior, of a terebinthinate odor and taste.

Oleum Terebinthinæ. Oil of Turpentine. (U. S. & B. P.)

A volatile oil distilled from turpentine.

Synonym.—Spirit of turpentine, E.; essence de térébinthine, Fr.; terpentinöl, G.

Properties.—A thin, colorless liquid, having a characteristic odor and taste, both of which become stronger and less pleasant by age and exposure to the air. Spec. gr. 0.860 to 0.870 at 77° F. Soluble in three times its volume of alcohol; also soluble in an equal volume of glacial acetic acid.

Solvent for resins (varnish), fats, wax, gutta percha, india rubber, sulphur, phosphorus, iodine, and many alkaloids. It is dextrorotatory, but the French variety is leavo-rotatory. Old oil of turpentine and French oil of turpentine (Pinus maratima) are oxidizing agents.

Constituents.—Turpentine contains 20 to 25 per cent. of oil of turpentine. Oil of turpentine is composed of several isomeric hydrocarbons, called terpenes, and having the formula $C_{10}H_{16}$. The chief ones in the oil are pinene, phellandrene, limonene, and dipentene.

The oil of juniper, savin, cubeb, caraway, cloves, thyme, etc., contain various terpenes. They differ from each other in their boiling points and direction in which they rotate the plane of polarization. The terpenes are oxidized into camphors.

Dose.—Carminative—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-iv. (4.-15.); D., ♏x.-xxx. (.6-2.).

Anthelmintic—H. & C., ʒ ii.-iv. (60.-120.); D., ʒ ss.-iv. (2.-15.).

Diuretic—H. & C., ʒ ii.-vi. (8.-24.).

PREPARATIONS.

Linimentum Terbinthinæ. Turpentine Liniment. (U. S. & B. P.)

Resin cerate, 650; oil of turpentine, 350; melt the resin cerate and add the oil of turpentine. (U. S. P.)

Oleum Terebinthinæ Rectificatum. Rectified Oil of Turpentine. (U. S. P.)

Derivation.—Made by shaking oil of turpentine with an equal volume of Solution of Sodium Hydroxide, and distillation.

Properties.—A thin, colorless liquid, having the same properties as oil of turpentine.

TEREBENUM. Terebene. $C_{10}H_{16}$. (U. S. & B. P.).

A liquid consisting of dipentene and other hydrocarbons, obtained by the action of concentrated sulphuric acid on oil of turpentine and subsequent rectification with steam.

Properties.—A colorless, or slightly yellowish, thin liquid, having a rather agreeable, thyme-like odor, and an aromatic, somewhat

terebinthinate taste. Spec. gr. about 0.850 at 77° F. Only slightly soluble in water, but soluble in 3 times its volume of alcohol, and in glacial acetic, or carbon disulphide.

Dose.—H. & C., 3 ii.-vi. (8.-24.); ♏v.-xv. (.3-1.).

TERPINI HYDRAS. Terpin Hydrate. $C_{10}H_{20}O_2 + H_2O$.
(U. S. P.)

The hydrate of the diatomic alcohol, Terpin.

Derivation.—Rectified oil of turpentine, alcohol and nitric acid are mixed together in shallow, porcelain dishes, and after three or four days terpin hydrate crystallizes out. The crystals are collected, drained, dried on absorbent paper, and purified by recrystallization in alcohol.

Properties.—Colorless, odorless crystals, having an aromatic, somewhat bitter taste. Soluble in 200 parts of water and in 10 parts of alcohol.

Dose.—H., 3 ss.-ii. (2.-8.); D., gr. v.-xx. (.3-1.3).

OIL OF TURPENTINE.

Action External.—Oil of turpentine is an irritant to the skin, causing itching, pain and redness, or even vesication, followed by local anesthesia. It produces intense irritability and restlessness when applied externally to some horses. The oil is antiseptic, disinfectant and parasiticide, being more penetrating to the skin than mustard or cantharides.

Action Internal.—Alimentary Canal.—The oil induces a sense of warmth in the stomach (man), and increases gastric secretion, motion and vascularity, but is too disagreeable to be used as a stomachic. In acting similarly in the bowels, particularly in stimulating the muscular coat, oil of turpentine is a useful carminative by exciting peristalsis and expelling gas in tympanites. Its antiseptic properties also antagonize intestinal fermentation.

Large doses occasion purging and are anthelmintic. Toxic doses create gastro-enteritis and sometimes intestinal ulceration. The irritation of the nerve endings in the digestive tract caused by turpentine, leads to reflex stimulation of the nervous system and heart.

Circulation.—Turpentine is readily absorbed into the blood. Experimental evidence is at variance with regard to the action of the oil on the circulation. Small doses apparently increase the force and frequency of the heart-beat, and slightly raise blood pressure. The vessels are somewhat contracted and the drug is employed to arrest hemorrhage in the digestive tract and in remote organs. It

is inferior to ergot as an hemostatic. Large doses of turpentine lower the cardiac force and frequency, and cause vascular dilatation and fall of blood pressure.

Respiration.—Oil of turpentine enhances the strength and rapidity of the respiratory movements, in small doses, but large quantities depress the respiration. The oil is easily absorbed by inhalation and is also eliminated in the breath. Inhalation of the oil stimulates the bronchial mucous membrane, acts as an antiseptic, and excites muscular contraction of the bronchial tubes and cough.

Authorities differ as to the influence of turpentine on bronchial secretion. Rossbach found that the inhalation of air saturated with turpentine diminished secretion, while the topical application of a watery solution increased secretion. The oil is essentially a local stimulating expectorant.

Nervous System.—Medicinal doses occasion mental exhilaration in man. Large doses cause dulness, languor, and unsteady gait in animals; while distinctly toxic doses produce coma, sensory paralysis, loss of reflex activity, and, at times, convulsions.

Kidneys and Genito-Urinary Tract.—The kidneys are very prone to irritation during its elimination. Small doses induce frequent micturition. Large quantities lead to albuminuria, pain in the lumbar region, hematuria, and constant painful passage of high-colored urine, owing to irritation of the urinary mucous membrane and muscular spasm of the urethra (strangury). Menorrhagia and dysmenorrhea occur in females under the influence of the oil. Acute nephritis and complete suppression of urine follow great toxic doses. The urine has sometimes the odor of violets.

Elimination.—Turpentine is eliminated in the urine, breath, and, to some extent, in the bile and intestinal mucus; slightly by the skin.

Toxicology.—Turpentine poisoning is not an uncommon occurrence from the administration of large doses (undiluted) by empirics. Post-mortem appearances reveal gastro-enteritis, sometimes congestion and inflammation of the lungs, and fatty degeneration of the liver, kidney and muscles, following prolonged use of the oil.

The action of terebene and terpin hydrate is very similar to oil of turpentine.

Administration.—Oil of turpentine is given with eight or more times its volume of cottonseed or linseed oil, gruel, or milk; and in emulsion with acacia or white of egg. An emulsion is made by shaking a single dose with powdered acacia, and adding water or oil. Terebene is administered in a similar manner. Terpin hydrate may be exhibited in pill, ball or alcoholic solution.

USES OF OIL OF TURPENTINE, TEREBENE AND TERPIN HYDRATE.

External.—Oil of turpentine is employed as a stimulant and counter-irritant with two or three parts of cottonseed oil and soap liniment, or as the official liniment in rheumatism, myalgia, sprains, shoulder lameness, swollen joints, gangrene, frost bites, burns and ulcers. Oil of turpentine is a very efficient disinfectant with which to sterilize the skin or accidental wounds when more appropriate agents are not at hand. It is serviceable in the same form and for the same actions applied to "sitfasts" and obstinate ulceration about the heels in horses, and in footrot of sheep. As a parasiticide, the oil, diluted two or three times with sweet oil, is painted on the skin to kill ringworm and lice.

Oil of turpentine is a valuable counter-irritant in relieving pain and inflammation of deep-seated parts. It is particularly useful in tympanitis, flatulent and spasmodic colic and peritonitis. In the first two named disorders, external application is combined with the internal and rectal exhibition of the drug. Oil of turpentine is less frequently employed over the chest in pleurisy and bronchitis. The turpentine stupe is the favorite method of applying the oil in abdominal troubles. A blanket is thoroughly sprinkled with turpentine, folded, and rolled into a cylindrical form which will fit into an ordinary pail. Boiling water is then poured on the blanket until it is saturated. The blanket is quickly wrung out, placed over and around the horse's trunk, covered with rubber protective and dry blankets, and allowed to remain in place fifteen to thirty minutes.

Uses Internal.—Digestive Tract.—Oil of turpentine is of greatest utility in colic and in expelling gas in tympany given internally (℥ ii.-Oii. of linseed oil) and per rectum. Enemata can also be employed for their stimulant action on the nervous system and circulation, in collapse. One or two ounces of oil of turpentine are dissolved in two or four ounces of cottonseed oil, when used as an enema for horses. Turpentine is an anthelmintic for round and tape worms. From two to four ounces of the oil with one ounce of oleoresin of aspidium in a pint of linseed oil, are recommended for the latter purpose in the case of horses. Old oil of turpentine is often advised as an antidote for phosphorus because it contains ozone and forms a harmless, camphor-like body—turpentine phosphoric acid. Its use has, however, been found worthless. Turpentine is occasionally given in indigestion, chronic diarrhea, and dysentery of horses and cattle, as a local stimulant and antiseptic.

Respiratory Organs.—Oil of turpentine is an efficient stimulating and antiseptic expectorant in subacute and chronic bronchitis;

and deodorant in gangrene of the lungs. It is administered internally, and by inhalation in the proportion of one teaspoonful to the quart of boiling water. Terebene is used as a substitute for oil of turpentine, as a stimulating expectorant, and is likewise prescribed as an antiseptic and carminative in flatulence, and as a genito-urinary stimulant. Terpin hydrate increases bronchial secretion and is employed in both acute and chronic bronchitis. Oil of turpentine has been found beneficial in verminous bronchitis of calves and lambs (caused by Strongulus micrurus and filaria), injected into the trachea midway in the neck, according to the following prescription:

℞

Ol. Terebinthinæ..... 3 i-ii.
Acid, Carbol.....
Glycerini .....
Chloroformi .....āā 3 ss.

M.
S. Inject in one dose.

"Gapes" in fowl, due to Syngamus trachealis, is cured by the same mixture diluted with 5 parts of oil and applied to the throat internally with a feather.

Verminous bronchitis in calves may also be cured by pouring into each nostril, once daily, 2 drams of turpentine with the head upturned. Also give internally, and to lambs with this disease, 1 dram in milk or gruels once daily.

Circulation.—Oil of turpentine is of some worth as a cardiac stimulant and hemostatic. It is said to have been exhibited in parturient fever and apoplexy of cattle with success. Bleeding from the nose, lungs, digestive tract, uterus, kidneys, and bladder, and hemorrhages occurring in purpura hemorrhagica, are sometimes stopped by the internal use of turpentine.

Genito-Urinary Tract.—Oil of turpentine is indicated as a stimulant in amenorrhea, chronic pyelitis and cystitis. The drug is contra-indicated in acute inflammation of the kidneys and alimentary canal.

Pix Burgundica. Burgundy Pitch. (B. P.)

The prepared, resinous exudation of Abies excelsa Poiret (nat. ord. Coniferæ).

Synonym.—Poix blanche, poix de Bourgogne, Fr.; Burgunder harz (pech), G.

Habitat.—Southern Europe, mountainous regions.

Properties.—Hard, yet taking gradually the form of the vessel in which it is kept; brittle, with a shining, conchoidal fracture; opaque or translucent; reddish-brown or yellowish-brown; odor agreeably terebinthinate; taste aromatic, sweetish, not bitter. It is almost entirely soluble in glacial acetic acid, or in boiling alcohol, and partly soluble in cold alcohol.

Constituents.—1, resin; 2, a volatile oil ($C_{10}H_{16}$).

Dose.—H. & C., ʒ i.-iii. (30.-90.); Sh. & Sw., 3 i.-ii. (4.-8.); D., gr. xx.-xl. (1.3-2.6).

PREPARATION.

Emplastrum Picis. Pitch Plaster. (B. P.)

Terebinthina Canadensis. Canada Turpentine. (U. S. & B. P.)

A liquid oleoresin obtained from Abies balsamea (Linné), Miller (nat. ord. Coniferæ).

Synonym.—Canada balsam, balsam of fir, balsamum Canadense, E.; baume de Canada, Fr.; Canadischer terpentin, G.

Habitat.—Canada and N. United States; west to Minnesota, south on mountains to Virginia.

Properties.—A yellowish or faintly greenish, transparent, viscid liquid, of an agreeable terebinthinate odor, and a bitterish, slightly acrid taste. When exposed to the air it gradually dries, forming a transparent varnish. It is completely soluble in alcohol, chloroform or benzol.

Constituents.—1, volatile oil, 20-30 per cent.; 2, a resin; 3, a soluble bitter principle.

Dose.—H. & C., ʒ i.-iii. (30.-90.); Sh. & Sw., 3 i.-ii. (4.-8.); D., gr. xx.-xl. (1.3-2.6).

ACTION AND USES OF BURGUNDY PITCH AND CANADA TURPENTINE.

Burgundy pitch is slightly stimulating to the skin and is used as a mild counter-irritant (in plaster) in rheumatism, strains, swelling of joints, and upon the chest. Burgundy pitch, Canada turpentine, crude turpentine, Venice turpentine, Bordeaux turpentine and Frankincense have much the same action and uses as oil of turpentine internally. They are administered in the same manner and in nearly identical doses, but are less commonly employed than the latter.

Resina. Rosin. (U. S. & B. P.)

The residue left after distilling off the volatile oil from turpentine.

Synonym.—Colophony, resin, E.; colophonum, P. G.; colophane, Fr.; kolophonium, geigenharz, G.

Properties.—Usually in sharp, angular fragments. A transparent, amber-colored substance, hard, brittle, pulverizable; fracture glossy and shallow-conchoidal; odor and taste faintly terebinthinate. Spec. gr. 1.070-1.080. Soluble in alcohol, ether, and fixed or volatile oils; also in solution of potassium or sodium hydrate.

Constituents.—Chiefly abietic acid anhydride ($C_{44}H_{62}O_{47}$), 80-90 per cent.

PREPARATIONS.

Ceratum Resinæ. Resin Cerate. (U. S. P.)

Synonym.—Basilicon ointment.

Rosin, 350; yellow wax, 150; lard, 500.

Ceratum Resinæ Compositum. (U. S. P.)

Contains oil of turpentine and linseed oil in addition to wax, suet and rosin.

Emplastrum Adhæsivum. Adhesive plaster. (U. S. P.)

Rubber, 20; petrolatum, 20; lead plaster, 960.

Emplastrum Resinæ. Resin Plaster. (B. P.)

Unguentum Resinæ. (B. P.)

ACTION AND USES OF ROSIN.

Rosin is a local stimulant and antiseptic externally. The cerate is an excellent preparation for burns, wounds, ulcers, and abraded surfaces. The fumes arising from burning rosin (on a hot shovel) are said to be of value when inhaled in chronic or subacute bronchitis.

Pix Liquida. Tar. (U. S. & B. P.)

An empyreumatic oleoresin obtained by the destructive distillation of the wood of Pinus palustris Miller, and of other species of Pinus (nat. ord. Coniferæ).

Synonym.—Resina empyreumatica liquida—goudron, goudron végétal, Fr.; theer, G.

Habitat.—United States.

Properties.—Thick, viscid, semi-fluid, blackish-brown; heavier than water, transparent in thin layers, becoming granular and opaque with age; odor empyreumatic, terebinthinate; taste sharp, empyreumatic.

Tar is slightly soluble in water; soluble in alcohol, fixed or volatile oils, and solutions of potassium or sodium hydrate.

Constituents.—Mainly—1, oil of turpentine; 2, methylic alcohol; 3, creosote; 4, guaiacol; 5, phenol; 6, pyrocatechin; 7, toluol; 8, xylol; 9, acetic acid; 10, acetone; 11, resins.

Dose.—H. & C., ℥ ss.-i. (15.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., ♏xv.-ʒ i. (1.-4.).

PREPARATIONS.

Unguentum Picis Liquidæ. Tar Ointment. (U. S. & B. P.)

Tar, 500; yellow wax, 150; lard, 350.

Pix Carbonis Preparata. Prepared Coal Tar. (B. P.)

Liquor Picis Carbonis. Solution of Coal Tar. (B. P.)

Oleum Picis Liquidæ. Oil of Tar. (U. S. P.)

A volatile oil distilled from tar.

Properties.—An almost colorless liquid when freshly distilled, but soon acquiring a dull, reddish-brown color, and having a strong tarry odor and taste. Spec. gr. about 0.965. Soluble in alcohol.

Pix Nigra. Pitch. (Non-official.)

A solid, shining, black, bituminous substance. Soluble in ether, oils, and aqueous alkaline solutions. It contains an altered resin, and a crystalline principle, Retine ($C_{18}H_{18}$).

Oleum Cadinum. Oil of Cade. (U. S. & B. P.)

A product of the dry distillation of wood of Juniperus Oxycedrus Linné (nat. ord. Coniferæ).

Synonym.—Oleum juniperi empyreumaticum, E.; huile de cade, Fr.; cadöl, G.

Habitat.—North Africa, Spain, France, and Portugal, on the borders of the Mediterranean, in waste places and stony hill-sides.

Properties.—A brownish or dark brown, clear, thick liquid; having a tarry odor, and an empyreumatic, burning, somewhat bitter taste. Spec. gr. about 0.990. It is almost insoluble in water, but imparts to it an acid reaction. Partially soluble in alcohol; completely soluble in ether, chloroform, or carbon disulphide.

Constituents.—The composition is similar to that of tar.
Dose.—Same as that of tar.

ACTION AND USES OF TAR, OIL OF CADE AND PITCH.

Externally, tar produces hyperemia, and, when rubbed continually into the skin, sometimes papules and pustules. It is a stimulant, rubefacient, antiseptic and parasiticide externally. Poisoning may follow the extensive application of large quantities of tar over a denuded surface, or if it be licked off the skin. Tar is mainly employed in veterinary medicine on the skin, and is a valuable remedy to relieve itching and as a local stimulant in chronic eczema ("grease"), and sometimes in moist eczema and erythema, psoriasis, pityriasis, pruritus, and lichen. It also destroys the parasites of mange and ringworm. It is applied with fat, vaseline, soap or alcohol, in the proportion of 1-2 to 10. The official ointment (1-2), is generally appropriate in the above-mentioned skin diseases, but may require dilution. The following preparation is serviceable on patches of scaly eczema:

Tar, soft or green soap, each two ounces; alcohol, two ounces. Pure tar painted over the surface with a brush, is often most efficient in obstinate cases of eruptive disorders. A lotion of oil of tar, sulphurated potassa, or Peruvian balsam, is more cleanly and suitable for house dogs with eczema. (See diet for eczema in dogs, section on foods and feeding, p. 612.) Tar is of the greatest utility in stimulating the growth of horn, and is the principal ingredient of hoof ointments for horses. It may be mixed with an equal part of lard for this purpose, or the following mixture is well spoken of: tar, yellow wax and honey, ¼ lb. each; lard, 1½ lbs.; glycerin, 3 ounces. Melt and mix the lard and wax together; add the other ingredients; stir while cooling. Oakum, soaked with tar, is frequently packed under leather, beneath the shoes on horses' feet, to soften and stimulate the horn and to cure thrush and canker. Tar is also a beneficial application for foot rot of sheep. Tar is usually kept on hand for farming purposes, and is therefore, a popular antiseptic and protective in the treatment of wounds and broken horns in cattle.

Internally.—Tar—on account of its constituents, phenol and creosote—in large quantities causes toxic effects, with symptoms resembling carbolic acid poisoning: *e.g.,* abdominal pain, vertigo, signs of gastro-intestinal irritation, and the passage of dark-colored urine. It is not exceedingly poisonous, however, as recovery has been reported in man after the ingestion of an amount varying from one to two pints. Tar is eliminated by the kidneys, with the production

of irritation and diuresis; also by the mucous membrane, and affects more especially that lining the bronchial tubes, where it acts as a local stimulant and antiseptic. For this reason the drug is an excellent expectorant in subacute or chronic bronchitis when given internally or by inhalation. The latter process may be conducted by pouring tar on a heated shovel, or, better, by dissolving tar in boiling sodium carbonate solution and steaming the patient with the vapor. Tar is occasionally exhibited in chronic gastro-intestinal catarrh and obstinate diarrhœa, with good results.

Tar is of value internally in influencing those skin disorders which are benefited by its external application. Inhalations of tar are sometimes serviceable in pharyngitis and laryngitis, as well as in bronchitis. Oil of tar may be applied, dissolved in alcohol (1-8), as a lotion, and is an agreeable substitute for tar in chronic eczema or psoriasis of dogs. It is used in the pure state as a parasiticide for mange, scab, ringworm or favus. Oil of cade represents oil of tar and tar in their actions and uses, but its odor is pleasanter. It is prescribed externally in chronic eczema and pruritis, as follows: Oil of cade, 1; soft soap and alcohol, 4 parts each; or in equal parts with wax. Oil of cade can also be used in any proportion or manner in which tar is applicable. Pitch likewise possesses the same action as tar, and is sometimes employed for making hoof ointments and plasters.

Balsamum Peruvianum. Balsam of Peru. (U. S. & B. P.)

A balsam obtained from Toluifera Pereiræ (Royle) Baillon (nat. ord. Leguminosæ).

Synonym.—Balsamum peruvianum nigrum, balsam indicum, baume de Péron, baume des Indes, Fr.; Peru balsam, G.

Habitat.—Central America.

Properties.—A liquid having a syrupy consistence, free from stringiness or stickiness; of a brownish-black color in bulk, reddish-brown or transparent in thin layers; of an agreeable, vanilla-like, somewhat smoky odor, and a bitter taste, leaving a persistent after-taste. On exposure to air it does not become hard. Spec. gr. 1.140 to 1.150. Miscible in all proportions, with absolute alcohol, chloroform, or glacial acetic acid. Completely soluble in 5 parts of alcohol.

Constituents.—1, a volatile oil, yielding cinnamein, $C_9H_7(C_7H_7)O_2$, about 60 per cent.; 2, cinnamic acid, $C_{19}H_8O_2$; 3, a resin (32 per cent.), yielding benzoic acid, $HC_7H_5O_2$ on dry distillation: 4, styrol, C_8H_8; 5, stilbene, $C_{14}H_{12}$; 6, a volatile oil, benzylic

benzoate, C_7H_5 $(C_7H_7)O_2$; 7, benzylic alcohol, C_7H_8O; 8, styracin, C_9H_7 $(C_9H_9)O_2$.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., ♏x.-xxx. (.6-2.).

Balsamum Tolutanum. Balsam of Tolu. (U. S. & B. P.)

A balsam obtained from Toluifera Balsamum Linné (nat. ord. Leguminosæ).

Synonym.—Baume de Tolu, baume de Cathagène, Fr.; Tolubalsam, G.

Habitat.—New Granada and Venezuela.

Properties.—A yellowish-brown, plastic solid, becoming brittle when old, dried or exposed to the cold; transparent in thin layers; having an agreeable odor, recalling that of vanilla, but distinct from it, and a mild aromatic taste. Soluble in alcohol, chloroform and solutions of fixed alkalies; almost insoluble in water.

Constituents.—1, a volatile oil, tolene, $C_{10}H_{16}$, 1 per cent.; 2, a volatile oil, benzylic benzoate, C_7H_5 $(C_7H_7)O_2$; 3, benzoic acid, $HC_7H_5O_2$; 4, cinnamic acid, $C_9H_8O_2$; 5, benzylic cinnamate, C_9H_7 $(C_7H_7)O_2$; 6, resins.

Dose.—Same as balsam of Peru.

PREPARATION.

Syrupus Tolutanus. **Syrup of Tolu. (U. S. & B. P.)**

Tincture of tolu, 50; magnesium carbonate, 10; sugar, 820; water to make 1000. (U. S. P.)

Dose.—**D., ʒ i.-iv. (4.-15.).**

ACTION AND USES OF BALSAMS OF PERU AND TOLU.

Externally, the balsams are stimulant, antiseptic and parasiticide. Balsam of Peru is a useful remedy in alcoholic solution (1-8) for chronic eczema of dogs. It may also be serviceable in ointment (1-8) for sore teats in cows, or as an application to kill lice and the parasites of (sarcoptic) mange and ringworm. It is, undiluted, a most excellent stimulant and antiseptic dressing upon wounds and ulcers. In fact there is no better agent for dressing ordinary wounds. Occasionally renal inflammation follows its very extensive external use.

Internally, the balsams are stomachic and carminative, and are eliminated by the skin, mucous membranes and urinary organs, stimulating these parts. They are therefore occasionally prescribed

in chronic bronchitis, pyelitis and cystitis. The syrup of tolu is an exceedingly mild preparation, but forms an agreeable vehicle for cough mixtures in canine practice. The balsams may be administered in emulsion rubbed up with either glycerin, mucilage, or white of egg and water.

Benzoinum. Benzoin. (U. S. & B. P.)

Synonym.—Resina benzoe, asa dulcis, gum benjamin, E.; benzoin, Fr.; benzoe, G.

A balsamic resin obtained from Styrax Benzoin Dryander, and another unidentified species of styrax (nat. ord. Styraceæ).

Habitat.—Siam, Sumatra, Java and Borneo.

Properties.—In pebble-like bodies or tears, mostly 0.5 to 5 Cm. long and about one-fourth as thick, slightly flattened, straight or curved, yellowish- to rusty-brown externally, milky-white on fresh fracture, separate or very slightly agglutinated (Siam Benzoin), or embedded in a dry resinous mass, which varies from reddish-brown to reddish-gray or grayish-brown; opaque or slightly translucent and more or less lustrous (Sumatra Benzoin); brittle, becoming soft on warming, and yielding benzoic acid on sublimation; odor agreeable, balsamic (vanilla-like in the Siam variety); taste slightly acrid. It is almost wholly soluble in 5 parts of moderately warm alcohol, and in solutions of the fixed alkalies. When heated it gives off fumes of benzoic acid.

Constituents.—1, benzoic acid, 12 to 20 per cent.; 2, cinnamic acid, sometimes; 3, several resins; 4, a volatile oil.

PREPARATIONS.

Adeps Benzoinatus. Benzoinated Lard. (U. S. & B. P.)

Made by melting lard, 1000, with benzoin, 20; and straining. (U. S. P.)

Tinctura Benzoini. Tincture of Benzoin. (U. S. P.)

Made by maceration of benzoin, 200, in alcohol; filtration, and addition of alcohol to make 1000.

Dose.—H. & C., ʒ i. (30.); D., 3 ss.-i. (2.-4.).

Tinctura Benzoini Composita. Compound Tincture of Benzoin. (U. S. & B. P.)

Synonym.—Friar's balsam.

Benzoin, 100; purified aloes, 20; storax, 80; balsam of tolu, 40; alcohol to make 1000. Made by digestion and filtration. (U. S. P.)

ACIDUM BENZOICUM. Benzoic Acid. $HC_7H_5O_2$.
(U. S. & B. P.)

Synonym.—Acide benzoique, fleurs de benjoin, Fr.; benzoesäure, benzoeblumen, G.

Derivation.—Obtained from benzoin by sublimation, or artificially prepared.

Properties.—White, or yellowish-white, lustrous scales or friable needles; odorless, or having a slight characteristic odor resembling that of benzoin, and of a warm, acid taste. Somewhat volatile at a moderately warm temperature, and rendered darker by exposure to light. Soluble, when pure, in about 281 parts of water, and in 1.8 parts of alcohol. Also soluble in 3 parts of ether, 7 parts of chloroform, and readily soluble in carbon disulphide, benzol, fixed and volatile oils, but sparingly soluble in benzin.

Incompatibles.—Alkalies, ammonium carbonate.

Dose.—H. & C., ℥ ii.-iv. (8.-15.); D., gr.v.-xv. (.3-1.).

AMMONII BENZOAS. Ammonium Benzoate. $NH_4C_7H_5O_2$.
(U. S. & B. P.)

Made by the action of benzoic acid and ammonia water. In white crystals. Soluble in 10.5 parts of water; in 25 parts of alcohol.

Dose.—Same as benzoic acid.

SODII BENZOAS. Sodium Benzoate. $NaC_7H_5O_2$.
(U. S. & B. P.)

Made by the action of a hot solution of sodium carbonate on benzoic acid. Occurs in a white powder. Soluble in 1.6 parts of water; in 43 parts of alcohol.

Dose.—Same as benzoic acid.

LITHII BENZOAS. (U. S. P.)

Dose.—Same as for sodium benzoate.

ACTION OF BENZOIN, BENZOIC ACID AND BENZOATES.

These substances may be represented by benzoic acid.

Action External.—Benzoic acid is an irritant applied externally, also when its vapor is inhaled. It is an efficient antiseptic; a solution (1-1000) will inhibit the growth of many forms of bacteria.

Action Internal.—Medicinal doses of benzoic acid exert only an antiseptic action in the alimentary canal. Large doses occasion increased bronchial and cutaneous secretion, with accelerated pulse. Enormous doses cause gastro-intestinal irritation, slowing of the pulse and respiration, convulsions, general paralysis and asphyxia. Benzoic acid is absorbed into the blood, acts as an antipyretic in fever, and is converted (probably in the kidneys) into hippuric acid and eliminated in the urine as such. It thus renders an alkaline urine acid, and stimulates and exercises an antiseptic influence upon the urinary mucous membrane. The change into hippuric acid is due to combination with a nitrogenous body—glycocoll—but the source of glycocoll is uncertain.

Benzoic acid $HC_7H_5O_2$ + glycocoll $C_2H_5NO_2$ = hippuric acid $C_9H_9NO_3$ + water H_2O.

Benzoic acid is somewhat diuretic, but does not alter the composition of the urine in any constant manner, although metabolism is said to be increased. It is eliminated by the bronchial mucous membrane, augmenting secretion, and acting as an antiseptic in the bronchial tubes. When the vapor of any of the substances under consideration is inhaled in proper dilution, a similar expectorant action is attained. Benzoic acid is likewise excreted by the skin and salivary glands, exciting their functional activity.

Uses External.—The compound tincture of benzoin is a valuable stimulant and antiseptic application for wounds, sores and ulcers. It is often applied to the part on gauze or lint, followed by bandaging.

Uses Internal.—Benzoic acid is sometimes given in powder, pill, or ball, as an intestinal antiseptic, and as a remedy for rheumatism. It is inferior to salicylic acid in the latter disorder. The benzoates are said to be equally efficient as antiseptics and have been highly recommended in diarrhea and dysentery.

Benzoin, in the form of the tincture, and the benzoates, are serviceable in laryngitis, tracheitis, and bronchitis, to promote secretion and antisepsis. An inhalation of the tincture (3 ii.-Oi. hot water) is also very serviceable in these diseases for the same purposes.

The benzoates are of value in pyelitis and cystitis, particularly in carnivora with a normal acid urine, to acidify and disinfect the decomposing urine and stimulate the tract. They should be given with hexamethylenamine in these disorders as this drug only acts favorably in an acid urine.

Sinapis Alba. White Mustard. (U. S. P.)

Synonym.—Sinapis albæ semina, B. P.; semen erucæ, yellow mustard seed, E.; moutarde blanche, Fr.; weisser senf, G.

The seed of Sinapis alba (Linné) nat. ord. Cruciferæ).

Habitat.—Southern Europe and Asia; cultivated in temperate climates.

Description.—About 2 Mm. in diameter; almost globular, with a circular hilum; testa yellowish, finely pitted, hard; embryo oily, with a curved radicle and two cotyledons, one folded over the other; free from starch; inodorous; taste pungent and acrid.

Constituents.—1, a glucoside, sinalbin ($C_{30}H_{44}N_2S_2O_{16}$), and a ferment, myrosin, 10-15 per cent. The latter converts the former, in the presence of water, into the active principle of the drug, acrinyl sulphocyanide (C_7H_7ONCS), a very acrid, volatile body, sinapine sulphate ($C_{16}H_{23}NO_5H_2SO_4$), and glucose; 2, a bland, fixed oil, 25 per cent.; 3, gum, 20 per cent.

Dose.—H., ʒ ss. (15.); C., ʒ ss.-i. (15.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. x.-xv. (.6-1.).

Sinapis Nigra. Black Mustard. (U. S. P.)

Synonym.—Sinapis nigræ semina, B. P.; semen sinapis, P. G.; moutarde noire (Grise), Fr.; schwarzer senf, G.

The seed of Brassica nigra (Linné) Koch (nat. ord. Cruciferæ).

Habitat.—Southern Europe and Asia; cultivated in temperate climates.

Description.—About 1 Mm. in diameter, almost globular, with a circular hilum; testa blackish-brown, or grayish-brown, finely pitted, hard; embryo oily, with a curved radicle and two cotyledons, one folded over the other; free from starch; inodorous when dry, but when triturated with water, of a pungent, penetrating, irritating odor; taste pungent and acrid.

Constituents.—1, a glucoside, sinigrin (or potassium myronate), and a ferment, myrosin. In the presence of water the latter converts the former into the acrid, volatile, official oil of mustard (allyl sulphocyanide, C_3H_5CNS), acid potassium sulphate, and glucose; 2, a fixed, bland oil, similar to that in white mustard; 3, gum.

Dose.—Same as white mustard.

Commercial form of mustard is a mixture of black and white mustard, and constitutes Sinapis (B. P.)

PREPARATION.

Oleum Sinapis Volatile. Volatile Oil of Mustard.

Synonym.—Oleum sinapis, B. P.; allyl sulphocyanide (C_3H_5CNS), allyl-iso-thiocynate, oleum sinapis æthereum, E.; essence de moutarde, Fr.; ætherisches senföl, G.

Derivation.—A volatile oil obtained from black mustard by maceration with water and subsequent distillation.

Properties.—A colorless or pale yellow, limpid and strongly refractive liquid, having a very pungent and acrid odor and taste. Freely soluble in alcohol, ether, or carbon disulphide, the solutions being neutral to litmus paper. Spec. gr. 1.013 to 1.020.

PREPARATION.—*Linimentum Sinapis* (B. P.); volatile oil of mustard, camphor and castor oil.

Action External.—Mustard quickly dilates the vessels of the skin and causes hyperemia. If its application is frequently repeated, there is so much vascular irritation that transudation of serum occurs under the epidermis, and blisters or even pustules are formed. Mustard induces a sensation of burning in man, but is not so irritating as oil of turpentine to horses, and the primary irritation is followed by partial anesthesia. It is one of the most useful counter-irritants, and by this action contracts vessels in the underlying parts, and relieves pain and congestion.

In rapidly stimulating the skin, mustard reflexly excites the nervous system, respiratory functions and heart. Mustard is therefore a rubefacient, vesicant, and counter-irritant externally.

Action Internal.—Mustard stimulates gastric vascularity, secretion and motion, and promotes the appetite in small doses. Large doses occasion vomiting in animals capable of the act. Intestinal peristalsis and secretion are probably likewise augmented by mustard. It is thus a stomachic, carminative and emetic internally, but is rarely administered save as a emetic because of its pungency and the difficulty attending its exhibition. Mustard is absorbed to some extent, but we are ignorant concerning its ultimate fate or remote action. It is said to be a diuretic.

Uses External. Mustard is an extremely valuable counter-irritant for relieving pain or congestion in almost any internal part. It is more commonly employed in the acute respiratory disorders of the domestic animals, as in laryngitis, bronchitis, congestion of the

lungs, pleurisy, pneumonia, to stop incessant cough, and after exposure to severe cold; and the flour of mustard is used in a very thin paste made with warm water and applied with friction to the skin. Boiling water should not be mixed with mustard, nor vinegar, nor alcohol, as they interfere with its action. The volatile oil of mustard is a cleanly and convenient substitute for the crude drug. A small quantity, diluted with olive oil, or cottonseed oil (1-15), may be rubbed into either side of the chest in bronchitis, pleurisy, and other chest disorders, as a counter-irritant.

After the application of mustard, the part may be bandaged, or hot blankets may be placed over the body and the treatment reinforced by the use of mustard on the limbs and bandaging. If mustard is employed continuously to keep up constant counter-irritation, the drug should be washed off in 20 or 30 minutes, and the process repeated once in 2 hours. It is unwise to induce much vesication over an extensive surface with mustard, as the result is painful and resolution is slow. Mustard is also serviceable in painful abdominal diseases, as colic, tympanites, enteritis and peritonitis, but oil of turpentine appears here to be more efficient.

A sinapism (mustard application) over the loins is useful in acute nephritis, and will not lead to irritation of the kidneys from absorption which may ensue after cantharidal blistering. Cantharides has, however, a more active, permanent and revulsant effect in most local inflammatory conditions, and is more potent in acute laryngitis. The action of mustard is rapid and fleeting, unless applied continually in considerable strength. For this reason it is indicated to impress the nervous system instantaneously, in opium, alcohol and other narcotic poisoning; in respiratory failure, in collapse and extreme depression in the course of acute diseases (pneumonia and parturient apoplexy), applied all over the body, or over the cardiac region in syncope. Mustard is of utility in muscular or articular rheumatism, and is employed on swollen glands (strangles), inflamed joints and tendons; but is usually less efficacious than a good cantharidal blister in these three latter conditions.

Uses Internal.—Mustard is an efficient emetic for dogs, in tablespoonful doses, given in a cup of tepid water. It is usually at hand, and not only empties the stomach in poisoning, but reflexly stimulates the heart and respiration. If administered for its carminative or stomachic effect, mustard must be given in pill or ball.

Thiosinamina. Thiosinamine. $C_4H_8N_2S$.

Thiosinamine (allyl thiourea) is made by heating together volatile oil of mustard and an alcoholic solution of ammonia, col-

lecting the crystalline product of condensation, and recrystallization from alcohol. It occurs in colorless crystals, having a slight, alliaceous odor, and is moderately soluble in water in which it is decomposed. It is also soluble in about 3 parts of alcohol and readily soluble in ether.

Fibrolysin (NH_2 CS. $NHCH_2$ CH: CH_2) + C_6H_4 (OH) (COONa) has now largely superseded thiosinamine because it is freely soluble in water, produces less irritation and is more readily absorbed than thiosinamine. Fibrolysin is a sterilized solution of a double salt of thiosinamine and sodium sulphate containing 15 per cent. of the double salt. It is a clear, colorless, aqueous solution of faint odor and acrid taste. It decomposes in the air but not in sealed, brown glass vials in which it is marketed. Each ampul contains 11.5 Cc., or sufficient for one injection for a horse.

Actions and Uses.—Thiosinamine and fibrolysin have a peculiar action on pathological exudates when given by the mouth, under the skin, or into the blood. They cause a local reaction, where old inflammatory exudation exists, with softening and absorption of inflammatory exudates beginning within a few hours after their subcutaneous use. There may be considerable pain and dark congestion about the site of injection and the amount of urine is sometimes greatly increased. While they are said not to interfere with the general health, in man they sometimes produce nausea and vomiting.

Fibrolysin is the better of the two for the reasons stated. It has been employed to cause resolution in indurated and thickened tendons, in anchylosis of joints, and elephantiasis of horses and cattle; also in swollen and indurated glands, in large scars and keloid growths, and corneal opacites. The value of the drug is still undetermined since reports have been more or less at variance.

Fibrolysin solution is probably best given intramuscularly into the gluteals, but may also be injected intravenously or subcutaneously once daily, or once every second or third day.

Eucalyptus. Eucalyptus. (U. S. P.)

Synonym.—Feuilles d'eucalyptus, Fr.; eucalyptus-blätter, G.

The dried leaves of Eucalyptus globulus Labillardière (nat. ord. Myrtaceæ), collected from the older parts of the tree.

Description.—Petiolate, lanceolately scythe-shaped; from 15 to 30 cm. long; 2 to 4 Cm. broad; rounded below, tapering above; entire, leathery, grayish-green, glandular, feather-veined between the

midrib and marginal veins; odor strongly camphoraceous; taste pungently aromatic and somewhat cooling, bitter and astringent.

Constituents.—1, a volatile oil (see below); 2, a crystallizable resin; 3, a crystallizable, fatty acid; 4, cerylic alcohol.

Dose.—H. & C., ʒ ii.-iii. (60.-90.); D., ʒ ss.-ii. (2.-8.).

PREPARATIONS.

Fluidextractum Eucalypti. Fluidextract of Eucalyptus. (U. S. P.)

Made by maceration, percolation and evaporation, so that 1 cc. = 1 gm. of the crude drug.

Dose.—Same as for eucalyptus.

Unguentum Eucalypti. (B. P.)

Oleum Eucalypti. Oil of Eucalyptus. (U. S. & B. P.)

A volatile oil is distilled from the fresh leaves of the eucalypus, rectified by steam distillation, and yielding when assayed, not less than 50 per cent. by volume of cineol (eucalyptol).

Properties.—A colorless or faintly-yellowish liquid, having a characteristic, aromatic, somewhat camphoraceous odor, and a pungent, spicy, and cooling taste. Spec. gr. 0.905 to 0.925. Soluble in all proportions in alcohol, carbon disulphide, or glacial acetic acid.

Constituents.—1, a volatile oil, eucalyptol or cineol ($C_{10}H_{18}O$); 2, eucalyptene ($C_{10}H_{16}$); 3, cymene ($C_{10}H_{14}$).

Incompatibles.—Alkalies, mineral acids, and metallic salts.

Dose.—H., ʒ i.-ii. (4.-8.); D., ♏ ii.-x. (.12-.6).

Eucalyptol. Eucalyptol. $C_{10}H_{18}O$. (U. S. P.)

An organic oxide (cineol) obtained from the volatile oil of Eucalpytus globulus Labillardière, and from other sources.

Derivation.—Crude eucalyptol distills over from eucalyptus leaves at a temperature varying from 338° to 352° F., and is purified by redistillation from potassium hydrate or calcium chloride.

Properties.—A colorless liquid, having a characteristic, aromatic and distinctly camphoraceous odor, and a pungent, spicy and cooling taste. Spec. gr. 0.925. Soluble in all proportions, in alcohol.

Dose.—Same as oil of eucalyptus.

ACTION OF EUCALYPTUS, OIL OF EUCALYPTUS AND EUCALYPTOL.

External.—The oil is a powerful antiseptic and disinfectant, and is even said to be three times more efficient in this respect than carbolic acid. It is but slightly irritating to the skin, unless its vapors are confined by bandaging, when it may cause vesicles and pustules. Some local anesthesia follows primary skin irritation.

Internal.—Digestive Tract.—Oil of eucalyptus excites gastric and salivary secretion, and acts, both locally and during elimination, as a stimulant to the mucous membrane of the alimentary canal. Large doses occasion diarrhea, and the fecal discharges are impregnated with the odor of the oil. It is a stomachic, carminative, antiseptic and anodyne in the digestive tract.

Circulation.—Oil of eucalyptus arrests the amœboid movements of the white blood corpuscles, and diapedesis, in inflammatory areas; inhibits the growth of the plasmodia malariæ; is an antipyretic and antiperiodic, and generally comports itself like quinine; but is nevertheless distinctly inferior to it. Small doses reflexly stimulate the heart and cause an increase in blood pressure; while toxic doses depress the heart's action and lower vascular tension.

Respiration.—Small doses accelerate the respiratory movements. Large doses make the respiration slower and weaker, and death ensues through respiratory failure.

Nervous System.—Poisonous quantities depress the brain, medulla and spinal cord. Reflex activity is lost. Animals stagger, suffer great loss of muscular power and sensation in their limbs, and fall; the breathing is slow and irregular, the pulse weak, and there are occasional convulsions. The breathing stops before the cardiac pulsations.

Elimination.—Oil of eucalyptus is excreted by the skin, kidneys, and mucous membrane of the bronchial tubes and bowels, and therefore stimulates and disinfects these parts during its elimination. Hence the drug is a diaphoretic, diuretic, and genito-urinary stimulant, stimulating expectorant, and carminative.

Administration.—The oil, or eucalyptol, are administered in emulsion with gum; dissolved in alcohol; or in capsules.

USES OF EUCALYPTUS, OIL OF EUCALYPTUS AND EUCALYPTOL.

External.—Eucalyptol is probably more generally useful than either eucalyptus or the oil. It is employed as an antiseptic with

vaseline (1-8), on sores, wounds, and ulcers, and in lubricating instruments for use in the cavities of the body. It partially disguises the odor of iodoform, and is frequently combined with the latter in ointment. Eucalyptol is serviceable as a stimulating, antiseptic and deodorant inhalation in catarrhal diseases of the respiratory tract with putrid discharges, and in pulmonary gangrene. The ordinary doses (by the mouth) are placed in hot water for this purpose. Eucalyptol, with sweet oil (1-5), forms an efficient stimulating and anodyne liniment.

Internal.—In chronic bronchitis, eucalyptol is often valuable in stimulating and disinfecting the bronchial mucous membrane during its elimination. It is also efficacious in chronic pyelitis and cystitis, for the same reason. The oil has been given with asserted success in various bacterial diseases, as septicemia, canine distemper, influenza, etc., for its antiseptic action. In human medicine, eucalyptus and its derivatives are mainly of worth as substitutes for quinine in malaria, when the latter drug is inadmissible. Eucalyptol may be given as a stomachic and carminative in digestive disorders with foul-smelling fecal evacuations.

Myrrha. Myrrh. (U. S. & B. P.)

Synonym.—Myrrhe, F.

A gum-resin obtained from Commiphora Myrrha (Nees) Engler (nat. ord. Burseraceæ).

Habitat.—Eastern Africa and Southwestern Arabia, along the borders of the Red Sea.

Description.—In roundish or irregular tears or masses; dusty, brownish-yellow or reddish-brown; fracture waxy, somewhat splintery; translucent on the edges, somewhat marked with whitish veins: odor balsamic; taste aromatic, bitter and acrid. When triturated with water, myrrh yields a brownish-yellow emulsion; it is soluble in alcohol.

Constituents.—1, an active resinous principle, myrrhin ($C_{48}H_{32}O_{10}$), 23 per cent.; 2, myrrhol ($C_{10}H_{14}O_1$), a volatile oil 2-4 per cent.; 3, arabin, a gum, 50 to 60 per cent.; 4, a bitter substance.

Dose.—H. & C., 3 ii.-iv. (8.-15.); Sh. & Sw., 3 ss.-i. (2.-4.); D., gr. v.-xxx. (.3-2.).

PREPARATIONS.

Tinctura Myrrhæ. Tincture of Myrrh. (U. S. & B. P.)

Made by maceration of myrrh, 200, with alcohol, and filtration to make 1000. (U. S. P.)

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., 3 iii.-vi. (12.-24.); D., 3 ss.-i. (2.-4.).

Tinctura Aloes et Myrrhæ. Tincture of Aloes and Myrrh. (U. S. P.)

Made by maceration and percolation of myrrh, 100; purified aloes, 100; glycyrrhiza, 100; with alcohol and water to make 1000. (U. S. P.)

Dose.—H. & C., ʒ ii.-iv. (60.-120.); Sh. & Sw., ʒ ss.-i. (15.-30.); D., 3 i.-ii. (4.-8.).

Pilulæ Aloes et Myrrhæ. (U. S. & B. P.)

Dose.—D., 2 pills.

Action and Uses.—Myrrh, externally, is a mild stimulant and antiseptic by virtue of its resin and volatile oil. It is a stomachic and carminative internally, exciting the appetite and increasing the secretion, motion and blood supply of the stomach and bowels. Myrrh is eliminated by the mucous membranes of the bronchial and genito-urinary tracts, and stimulates and disinfects these parts during its excretion. The drug is occasionally prescribed as a stimulating expectorant in chronic bronchitis; as a stimulant and antiseptic in chronic cystitis; also as a uterine stimulant and emmenagogue in ammenorrhea, and in chronic leucorrhea.

Myrrh is thought to prove beneficial in anemia, when combined with iron. It assists the action of purgatives, and myrrh may be exhibited as a laxative in the form of the tincture of aloes and myrrh. The tincture forms a serviceable mouth-wash in aqueous emulsion (1-16), and is sometimes employed as a stimulant and antiseptic on wounds, sores and ulcers, diluted with 4 to 8 parts of water. Myrrh is administered in tincture, ball or pill.

Class 2.—Used Mainly for their Stomachic and Carminative Action Upon the Digestive Tract.

Capsicum. Capsicum. (U. S. P.)

Synonym.—Capsici fructus, B. P.; cayenne pepper, African or pod pepper, E.; capsiqua, piment des jardins, pigment rouge, poivre de cayenne, Fr.; spanischer pfeffer, G. Called commonly "red pepper," when dried and powdered.

The dried, ripe fruit of Capsicum fastigiatum Blume (nat. ord. Solanaceæ) deprived of its calyx.

Habitat.—Tropical America; cultivated also in other tropical countries.

Description.—Oblong-conical, from 10 to 20 Mm. long; supported by a flattish, cup-shaped, five-toothed calyx with a red, shining, membranous and translucent pericarp enclosing two cells and containing 10 to 20 flat, reniform, yellowish seeds, attached to a thick, central placenta. It has a peculiar odor, and an intensely hot taste.

Constituents.—1, capsaicin ($C_9H_{14}NO_2$), a crystallizable, acrid body; 2, capsicin, a volatile alkaloid; 3, a fixed oil; 4, fatty matter; 5, resin.

Dose.—H., gr. xx.-℥ i. (1.3-4.); C., ℥ i.-ii. (4.-8.); D., gr. i.-viii (.06-.5).

PREPARATIONS.

Fluidextractum Capsici. Fluidextract of Capsicum. (U. S. P.)

Made by maceration and percolation with alcohol, and evaporation, so that 1 cc. = 1 gm. of the crude drug.

Dose.—H., ♏xx. ℥ i. (1.3-4.); C., ℥ i.-ii. (4.-8.); D., ♏i.-viii. (.06-.5).

Tinctura Capsici. Tincture of Capsicum. (U. S. & B. P.)

Made by percolation of capsicum, 100, with alcohol and water to make 1000. (U. S. P.)

Dose.—H., ℥ ii.-iv. (8.-15.); C., ʒ ss.-i. (15.-30.); D., ♏v.-℥ i. (.3-4.).

Oleoresina Capsici. Oleoresin of Capsicum. (U. S. P.)

Made by percolation with acetone, distillation, and evaporation of the residue.

Dose.—H., ♏x.-xxx. (.6-2.); C., ℥ ss.-i. (2.-4.); D., ♏¼-i. (.015-.06).

Unguentum Capsici. (B. P.)

Administration.—Capsicum and the oleoresin are given in ball or pill. The fluidextract should be freely diluted with water.

Action and Uses.—Capsicum generally resembles the volatile oils in its action. Externally, it is rubefacient and counter-irritant, producing about the same degree of irritation as mustard, but causing considerably more pain, while its fumes are unbearable. Capsicum is used mainly as a stomachic and a carminative in augmenting the appetite, gastric vascularity, secretion and motion, and intestinal peristalsis. Capsicum is employed on the skin in local paralysis—as of the lip—in horses, with mustard in paste; or as the fluidextract painted on plaster splints to prevent dogs from gnawing them off.

Internally, capsicum is of greater value than black or white pepper, and is indicated in atonic indigestion and flatulent colic in horses (see ammonium carbonate, p. 140). It may be combined advantageously with bitters, as nux vomica. Capsicum is a favorite stimulant and tonic remedy—to the digestion—with bird fanciers. It is also said to increase the laying of eggs when given to hens.

Zingiber. Ginger. (U. S. & B. P.)

Synonym.—Ingwer, G.; gingember, Fr.

The dried rhizome of Zingiber officinale Roscoe (nat. ord. Zingiberaceæ).

Habitat.—East and West Indies and India; cultivated in tropical climates.

Description.—Laterally compressed, irregularly branched pieces; externally whitish or pale buff, longitudinally striate; fracture short-fibrous, mealy, showing numerous small oil and resin cells and circular groups of fibrovascular bundles; odor agreeably aromatic; taste aromatic and pungent.

Constituents.—1, a volatile oil (¾ to 2 per cent.); 2, a resin; 3, gingerol, said to supply pungent taste, while the oil gives flavor.

Dose.—H., ʒ ii.-ʒ i. (8.-30.); C., ʒ i.-iv. (30.-120.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. v.-xv. (.3-1.).

PREPARATION.

Fluidextractum Zingiberis. Fluidextract of Ginger. (U. S. P.)

Made by maceration and percolation with alcohol, and evaporation, so that 1 cc. = 1 gm. of the crude drug.

Dose.—Same as that of ginger.

Oleoresina Zingiberis. (U. S. P.)

Dose.—H., gr.xxx.-ʒ i.ss. (2.-6.); D., gr.i.-v. (.06-.3).

Action and Uses.—Ginger is chiefly administered in powder as a stomachic and carminative in atonic indigestion of horses and ruminants. It is frequently combined with sodium bicarbonate and bitters. Ginger also aids the action of purgatives and prevents griping. The powder or fluidextract should be added to magnesium sulphate when it is given in full purgative doses to cattle or sheep. (See magnesium and sodium sulphate, p. 154).

Mentha Piperita. Peppermint. (U. S. P.)

Synonym.—Folia (herba) menthæ piperitæ, P. G.; menthe poivrée, Fr.; pfefferminze, G.

The dried leaves and flowering tops of Mentha piperita Linné (nat. ord. Labiatæ).

Habitat.—Indigenous in North America, Europe and Asia.

Description.—Branches quadrangular, with scattered, deflexed hairs; leaves petiolate, ovate-lanceolate, 3 to 8 Cm. long, acute, sharply serrate, light or dark green; flower-whorls in oblong or oval spikes which are usually compact, or somewhat interrupted at the base, 1 to 1.5 Cm. broad, rounded at the summit, when in fruit becoming 3 to 7 Cm. long; calyx tubular, 5-toothed and often purplish; corolla small, purplish, and 4-lobed; stamens four, short and equal; odor strong and characteristic; taste pungent and cooling.

Constituents.—1, a volatile oil; 2, menthol; 3, menthene ($C_{10}H_{18}$).

Oleum Menthæ Piperitæ. Oil of Peppermint. (U. S. & B. P.)

Synonym.—Essence de menthe poivrée, Fr.; pfefferminzöl, G.

Properties.—A volatile oil distilled from the fresh or partly dried leaves and flowering tops of Peppermint, rectified by steam distillation, and yielding, when assayed, not less than 8 per cent. of ester, calculated as menthyl acetate, and not less than 50 per cent. of total menthol (free and as ester). A colorless liquid, having the characteristic strong odor of peppermint, and a strongly aromatic, pungent taste, followed by a sensation of cold when air is drawn into the mouth. Spec. gr. 0.894 to 0.914 at 77° F.

It forms a clear solution with an equal volume of alcohol, but becomes turbid when somewhat further diluted.

Constituents.—1, menthol; 2, menthene, a liquid terpene obtained by distillation.

Dose.—H. & C., ℥xv.-xxx. (1.-2.); D., ℥i.-v. (.06-.3).

PREPARATIONS.

Spiritus Menthæ Piperitæ. Spirit of Peppermint. (U. S. & B. P.)

Synonym.—Essence de menthe poivrée, Fr.; Englisch pfefferminzessenz, G.; spiritus menthæ piperitæ anglicus, P.G.

Oil of peppermint, 100; peppermint, 10; alcohol to make 1000. Made by maceration and filtration. (U. S. P.)

Dose.—H. & C., 3 ii.-iv. (8.-15.); D. ♏xv.-xxx. (1.-2.).

Aqua Menthæ Piperitæ. Peppermint Water. (U. S. & B. P.)

Oil of peppermint, 2; purified talc, 15; water to make 1000. Made by trituration and filtration. (U. S. P.)

Dose.—Used as vehicle in canine practice.

Menthol. Menthol. $C_{10}H_{10}OH$. (U. S. & B. P.)

Synonym.—Mint or peppermint-camphor.

A stearopten (having the character of a secondary alcohol) obtained from the official oil of peppermint (from Mentha piperita Linné), or other peppermint oils.

Derivation.—Made from the oil of peppermint by fractional distillation; freezing of the higher boiling point product, and crystallization.

Properties.—Colorless, acicular or prismatic crystals, having a strong and pure odor of peppermint, and a warm, aromatic taste, followed by a sensation of cold when air is drawn in the mouth. Slightly soluble in water; freely soluble in alcohol, ether, chloroform, carbon disulphide or glacial acetic acid. When it is triturated with about an equal weight of camphor, thymol, or chloral hydrate, the mixture becomes liquid. Menthol may be dissolved by heat in oleic acid, fats or liquid vaseline.

Dose.—H., gr. vii.-xv. (.5-1.); D., gr. ss.-ii. (.03-.12).

ACTION AND USES OF PEPPERMINT AND MENTHOL.

Peppermint and oil of peppermint owe their medicinal virtues chiefly to the menthol they contain. They resemble the other volatile oils in most respects, but are more anesthetic and antiseptic than some. Menthol is used mostly externally, and is extremely valuable in relieving itching and neuralgic pain. It may be employed with

alcohol or chloroform in solution (3 ss. to ℥ i.) in urticaria or pruritus. An ointment is also serviceable, or a solution by heat in oleic acid (1 to 24). For burns, the following will be found beneficial: Sweet oil and lime water, each one ounce; menthol, one drachm. The cooling sensation produced by menthol is due to a specific effect upon the nerves of temperature. The anesthetic and antiseptic action of menthol has been taken advantage of in the treatment of boils and superficial abscesses. A 10 to 50 per cent. solution in ether is said to abort these lesions when painted frequently on the inflamed parts. A menthol and camphor solution, obtained by dissolving fifteen grains of each in an ounce of liquid petrolatum, is one of the best preparations to use in a medicine dropper for acute or chronic nasal catarrh of dogs.

Internally, the essence of peppermint or oil are of worth in cases of mild colic and flatulence on account of their anesthetic, carminative and antiseptic action. Menthol may be given to dogs to relieve vomiting. Peppermint water assuages thirst in fever, and this preparation is also used as a pleasant vehicle in the administration of disagreeable drugs to dogs. The oil is prescribed in pill or ball to prevent the griping of cathartics.

Administration.—The essence is the preparation in most common use and is given in water. The oil is dissolved in spirit, or exhibited to dogs on sugar. Menthol may be administered in alcohol and syrup, equal parts; or in pill or capsule to dogs.

Mentha viridis (spearmint) is official together with oleum menthæ viridis (oil of spearmint), spiritus menthæ viridis (spirit of spearmint), and aqua menthæ viridis. The actions, uses and doses are the same as those of peppermint and its preparations, but the latter are more popular and pleasant.

Anisum. Anise. (U. S. P.)

Synonym.—Anisi fructus, B. P.; anis, Fr.; anis, G.

The fruit of Pimpinella Anisum Linné (nat. ord. Umbelliferæ).

Habitat.—Southeastern Europe, Egypt, Western Asia; also cultivated.

Description.—Ovoid, laterally compressed, 4 to 5 Mm. long; carpels usually cohering and attached to a slender pedicel; grayish or greenish-gray to grayish-brown; each with a flat face and five light brown filiform ridges and about 16 oil-tubes; odor and taste agreeable and aromatic.

No mouse-like odor should be developed when solution of potassium hydroxide is poured upon Anise (absence of *conium*).

Constituents.—Oil of anise.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ ii.-iii. (8.-12.); D., gr. x.-xxx. (.6-2.).

Oleum Anisi. Oil of Anise. (U. S. & B. P.)

A volatile oil distilled from anise or from the fruit of star anise.

Properties.—A colorless or pale yellow, thin and strongly refractive liquid, having the characteristic odor of anise, and a sweetish, mildly aromatic taste. Spec. gr. about 0.975 to 0.985. Soluble in an equal volume of alcohol.

Dose.—H., ♏xx.-xxx. (1.3-2.); D., ♏i.-v. (.06-.3).

PREPARATIONS.

Aqua Anisi. Anise Water. (U. S. & B. P.)

Oil of anise, 2; purified talc, 15; water to make 1000. (U. S. P.) Used as vehicle.

Spiritus Anisi. Spirit of Anise. (U. S. & B. P.)

Oil of anise, 100; deodorized alcohol, 900. (U. S. P.)

Dose.—D., ʒ i.-ii. (4.-8.).

ACTIONS AND USES OF ANISE.

Oil of anise resembles in action the other volatile oils. It is employed with olive oil or alcohol (1-10) to kill fleas or lice on dogs, rubbed over the skin; and one drop of the pure oil may be placed on the feathers of fowl to cause destruction of lice. The oil is sometimes prescribed to disguise the taste or odor of drugs (see potassa sulphurata), and is ordered in cough mixtures for its expectorant properties.

Anise fruit is given to horses and ruminants on their food—frequently with sodium bicarbonate and ginger—to relieve mild forms of indigestion and flatulence through its stomachic and carminative action.

Cardamomum. Cardamom. (U. S. P.)

Synonym.—Cardamomi semina, B. P.; fructus vel semen cardamomi minors, P. G.; cardamomes, Fr.; cardamomen, kleine kardamomen, G.

The dried, nearly ripe fruit of Elettaris repens (Sonnerat) Baillon (nat. ord. Scitamineæ).

Habitat.—Malabar.

Description.—Fruit ovoid or oblong, from 10 to 15 Mm. long; of a pale buff color, with a thin, tasteless pericarp. Seeds 4 Mm. long, reddish-brown, and have an agreeable odor and a pungent, aromatic taste. The seeds are active; the pericarp has no medicinal virtue.

Constituents.—1, a volatile oil, which is a terpene ($C_{10}H_{16}$); 2, a fixed oil.

Dose.—Same as that of anise.

A tinctura and tinctura cardamomi composita are official. They serve as coloring (red) and flavoring agents, and may be employed as vehicles in doses of one to two drachms, in canine practice. The dose of the fluidextract is the same as that of the drug.

Coriandrum. Coriander. (U. S. P.)

Synonym.—Coriandri fructus, B. P.; coriander fruit, E.; coriandre, Fr.; koriander, G.; fructus coriandri, P. G.

The dried, ripe fruit of Coriandum sativum Linné (nat. ord. Umbelliferæ).

Habitat.—Southern Europe or Central Asia.

Description.—Globular, about 4 Mm. in diameter, brownish-yellow; odor and taste agreeably aromatic.

Constituents.—1, the volatile oil, oleum coriandri, a colorless, or slightly yellow liquid, having the characteristic odor of coriander, and a warm, spicy taste.

Dose of coriander and its oil, same as for anise and its oil.

Fœniculum. Fennel. (U. S. P.)

Synonym.—Fœniculi fructus, B. P.; semen fœniculi, fennel fruit or seeds, E.; semences de fenouil, Fr.; fenchelsamen, G.

The dried, nearly ripe fruit of Fœniculum Vulgare, Miller (nat. ord. Umbelliferæ).

Habitat.—Southern Europe and Levant.

Description.—Oblong, nearly cylindrical, from 4 to 8 Mm. long; brownish or greenish-brown; odor and taste aromatic, anise-like.

Constituents.—A volatile oil of almost similar action and com-

position to oil of anise, oleum fœniculi. A colorless, or pale yellowish liquid, having the characteristic aromatic odor of fennel, and a sweetish, mild and spicy taste. Soluble in alcohol.

Dose of fennel and its oil, same as that for anise and its oil.

Fœnugreek. (Non-official.)

The seeds of Trigonella fœnum græcum, cultivated in France and Germany. They are oblong, cylindrical, somewhat compressed, obliquely truncated at each end; 1 to 2 lines long; of a brownish-yellow color, and have a strong, peculiar odor, and oily, bitterish taste. Fœnugreek contains both a volatile and fixed oil.

Dose.—Same as for anise.

Actions and uses of cardamom, coriander, fennel and fenugreek.

These drugs resemble anise in actions, uses, and doses. They enter into the composition of many popular tonic or "condition" powders and drinks, and, by their stomachic and carminative properties, aid digestion. Ginger is perhaps in more frequent demand than other agents of this class, by the profession.

Class 3.—Used Mainly for Their Antispasmodic Action in Stimulating the Nervous System.

Valeriana. Valerian. (U. S. P.)

Synonym.—Valerianæ rhizoma, B. P.; valeriane, Fr.; baldrianwurzel, G.

The rhizome and roots of Valeriana officinalis Linné (nat. ord. Valerianaceæ).

Habitat.—Europe and Northern Asia. Naturalized in New England.

Description.—Rhizome from 2 to 4 Cm. long, and 1 to 2 Cm. thick; upright, subglobular, or obconical; truncate at both ends; brown or yellowish-brown, internally whitish or pale brownish, with a narrow circle of white wood under the thin bark. Roots numerous,

slender, brittle, brown, with a thick bark, and slender, ligneous cord. Odor peculiar, becoming stronger and unpleasant on keeping; taste camphoraceous and somewhat bitter.

Constituents.—1, a volatile oil (½ to 2 per cent.), consisting of pinene, a terpene, and Borneol, $C_{10}H_{18}O$; 2, valeric acid ($C_5H_{10}O_2$), a colorless, oily acid, with burning taste and odor of valerian. Soluble in alcohol and ether, and in 30 parts of water. Valeric acid is also made artificially by a complicated process from the distillation of chromic acid and amylic alcohol; 3, tannic acid; 4, resin; 5, malic, formic and acetic acids.

Dose.—H. & C., ʒ i.-ii. (30.-60.); D., gr. x.-ʒ i. (6.-4.).

PREPARATIONS.

Fluidextractum Valerianæ. Fluidextract of Valerian. (U. S. P.)

Made by maceration and percolation with water, and evaporation, so that 1 cc. = 1 gm. of the crude drug.

Dose.—H. & C., ʒ i.-ii. (30.-60.); D., ♏x.-ʒ i. (.6-4.).

A tinctura valerianæ (1-5) and a tinctura valerianæ ammoniata (1-5), prepared with aromatic spirit of ammonia, are also official. The dose of either is ʒ ss.-ii. (2.-S.), for dogs.

Tinctura Valerianæ Ammoniata. (B. P.)

Dose.—D., ʒ ss.-i. (2.-4.).

Ammonii Valeras. Ammonium Valerate. $NH_4C_5H_9O_2$. (U. S. P.)

Synonym.—Ammonium valerianate.

Made by the action of ammonia gas upon valerianic acid, and crystallization.

Properties.—Colorless, or white, quadrangular plates, emitting the odor of valeric acid, of a sharp and sweetish taste, and deliquescent in moist air.

Very soluble in water and in alcohol; also soluble in ether.

Dose.—D., gr. ii.-v. (.12-.3).

Ferri Valeras. Ferric Valerate. (Non-official.)

Made by precipitating a solution of ferric sulphate with a solution of sodium valerianate, and washing and drying the precipitate.

Properties.—A dark, brick-red, amorphous powder of somewhat varying chemical composition; having the odor of valerianic acid and a mildly styptic taste; permanent in dry air. Insoluble in cold water, but readily soluble in alcohol.

Dose.—D., gr. i.-iii. (.06-.18).

Zinci Valeras. Zinc Valerate. $Zn(C_5H_9O_2)_2 + 2\ H_2O$. (U. S. & B. P.)

Synonym.—Zinc valerianate.

Made by crystallization from a mixture of hot solutions of zinc sulphate and sodium valerate.

Properties.—White, pearly scales, having the odor of valeric acid, and a sweetish, astringent and metallic taste. On exposure to the air it slowly loses valeric acid. Soluble in 50 parts of water, and in 35 parts of alcohol.

Incompatibility.—Incompatible with acids, metallic salts and soluble carbonates; also vegetable astringents.

Dose.—D., gr. i.-iii. (.06-.18).

Administration.—Valerian should be given in the form of the fluidextract to horses, and this preparation or the tinctures may be exhibited to dogs in dilution. Valeric acid is not used in medicine except to make valerianates. Of the salts, the zinc valerate is the most popular, and is administered in pills to canine practice.

ACTION AND USES OF VALERIAN AND VALERATES.

The physiological action of valeric acid and the valerates is an unknown quantity, but clinical evidence supports their value. The volatile oil in valerian has much the same properties as other volatile oils in stimulating secretion, motion, vascularity and appetite, in relation to the digestive organs; and, in its elimination, the oil excites the mucous membranes of the bronchial tubes and genito-urinary tract. The oil also stimulates the circulation reflexly. Toxic doses of the oil paralyze the brain and cord and depress the circulation; while lethal quantities of ammonium valerate are said to first excite the spinal motor tract and cause convulsions, and to finally occasion spinal depression and paralysis. Valerian and the valerates are called antispasmodics in stimulating and strengthening an enfeebled nervous system and thus combating disorders which are created by an increased susceptibility to impulses originating within the brain,

or outside of the body. Valerian is both recommended and used in the treatment of polyuria and diabetes insipidus of the horse; in chorea of dogs resulting from distemper, and occasionally in hysteria, epilepsy, convalescence from acute diseases, and nervous restlessness. Although the drug is of secondary importance, it finds a much larger field of usefulness in human medicine.

Zinc valerate is more commonly employed in canine practice for chorea. Ferric valerate is supposed to combine the tonic and antispasmodic action of the two constituents in one preparation. The oil of valerian is a useful remedy (in emulsion) as a carminative in flatulence. It may be given to horses in doses of ʒ ss.-i.; and to dogs in quantities of ♏ii.-v.

Asafœtida. Asafetida. (U. S. P.)

Synonym.—Asafetida, B. P.; Gummi-resina asafœtida, ase fétide, asafœtida, Fr.; stinkasant, teufelsdreck, G.

A gum-resin obtained from the root of Ferula fœtida (Bunge) Regel (nat. ord. Umbelliferæ) and probably other species of Ferula.

Habitat.—Persia, Afghanistan and Turkestan.

Properties.—In roundish tears, from 2 to 6 Mm. or more in diameter; externally pale yellowish-brown, internally milk-white; brittle when cold, and breaking with a flat, conchoidal, and waxy fracture; or the tears are superficially united into irregular masses without any intervening dark-colored substance. It has a peculiar odor, and a bitter, acrid, nauseous taste. When triturated it readily yields a milk-white emulsion.

Constituents.—1, a volatile oil (5 per cent.), containing as its most important ingredient, allyl sulphide, which gives asafœtida its disagreeable odor; 2, gum, about 25 per cent.; 3, bassorin resin, 65 per cent., containing ferulaic acid ($C_{10}H_{10}O_4$).

Dose.—H. & C., ʒ ss.-i. (15.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. iii.-xii. (.18-.8).

Administration.—Asafœtida is given in ball to the larger animals or in an extemporaneous emulsion which is readily made—owing to the gum in the drug—by trituration with water. Asafetida is administered to dogs in pill. The drug may also be injected in aqueous mixture per rectum.

Preparations.—Pilulæ asafœtidæ (gr. iii. each); dose—D., 1-4. Tinctura asafœtidæ (1-5); dose—H., ʒ ii.-iv. (60.-120.); D., ʒ ss.-i. (2.-4.). Emulsum (mistura) asafœtidæ, milk of asafetida (1-25); dose—D., ʒ ss.-i. (15.-30.).

Action and Uses.—Asafetida is of value by reason of its volatile oil, and therefore possesses much the same action as other agents of this class. In experiments on man asafetida caused "stomachache," activity of the bowels, increased pulse rate and respiratory movements, headache, dizziness, and sexual desire.

Asafetida is chiefly used as a carminative, stimulating expectorant, and nerve stimulant or antispasmodic. Liquid preparations may cause nausea and vomiting in dogs owing to the nauseous taste. The drug is of most service in flatulent colic of horses, when it is combined with ammonium carbonate in ball, or is given in this form simultaneously with linseed oil and oil of turpentine.

In atonic constipation of horses, asafetida is prescribed with aloes in ball. Asafetida is occasionally employed as a stimulating expectorant in chronic bronchitis, and in the later stages of bronchial catarrh, but it is probably inferior to ammoniacum for this purpose. As an antispasmodic agent, asafetida is useful in functional spasmodic affections, including hysteria, chorea and convulsions. The emulsion may be given in enema to dogs, in the two latter disorders.

Finally, tincture of asafetida is recommended to be added to alcoholic liquors in veterinary practice to prevent their "misappropriation" by stable attendants.

Class 4.—Used Mainly for their Stimulant and Diuretic Actions on the Kidneys and Genito-Urinary Tract.

Buchu. Buchu. (U. S. P.)

Synonym.—Buchu folia, B. P.; feuilles de bucco, Fr.; buckublätter, buccoblätter, G.

The dried leaves of Barosma betulina (Thunberg) Bartling et Wendland (nat. ord. Rutaceæ).

Habitat.—South Africa.

Description.—About 15 Mm. long, roundish, obovate, with a rather wedge-shaped base, or varying between oval and obovate, obtuse, crenate or serrate, with a gland at the base of each tooth; dull yellowish-green; thickish, pellucid-punctate; odor and taste strongly aromatic, somewhat mintlike, pungent and bitterish.

Constituents.—1, a volatile oil, having an odor somewhat like peppermint, 1½ per cent.; 2, a stearopten (Buchu camphor or diosphenol, $C_{10}H_{16}O_2$), possessing an odor like peppermint and in solution in a liquid hydrocarbon, but crystallizing on exposure to the air; 3, barosmin, a glucoside, soluble in ether, volatile oils, diluted acids and alkalies; 4, gum; 5, rutin, a bitter substance.

Dose.—H. & C., ʒ i.-ii. (30.-60.); D., gr. xv.-xxx. (1.-2.).

PREPARATIONS.

Fluidextractum Buchu. Fluidextract of Buchu. (U. S. P.)

Made by maceration, percolation and evaporation, so that 1 Cc. = 1 Gm. of Buchu.

Dose.—H. & C., ʒ i.-ii. (30.-60.); D., ♏xv.-xxx. (1.-2.).

An infusion (1-20) by steeping leaves in boiling water for half an hour in a closed vessel, is sometimes preferred, and will be taken voluntarily by the larger animals in linseed tea.

Tinctura Buchu. Tincture of Buchu. (B. P.)

Dose.—Same as that of the fluidextract.

ACTION AND USES.

The volatile oil and bitter principle act upon the digestive organs as an aromatic bitter, promoting appetite and digestion in small doses, while large doses cause nausea and vomiting in dogs. The volatile oil is absorbed and eliminated by the mucous membranes, particularly of the bronchial tubes and genito-urinary tract. It thus stimulates and disinfects the mucous membranes, slightly increases the secretion of urine, and imparts its peculiar odor to the latter.

The drug is of considerable value in the treatment of chronic or subacute pyelitis, cystitis and urethritis. It is stimulating, but only slightly irritating. Buchu has been recommended in chronic nephritis, and is useful in irritation of the urinary bladder, with frequent micturition, combined with spirit of nitrous ether. Buchu is occasionally prescribed in the later stages of bronchitis or in the chronic form of this disease, and is employed in its native country as a remedy for chronic diarrhea and dysentery.

Oleum Juniperi. Oil of Juniper. (U. S. & B. P.)

Synonym.—Oleum fructus (Vel Baccæ) juniperi, oil of juniper berries, E.; essence de genièvre, Fr.; wachholderbeeröl, G.

A volatile oil distilled from the fruit of Juniperus Communis Linné (nat. ord. Coniferæ.)

Habitat.—Canada and United States; Rocky Mountains, south to New Mexico.

Properties.—A colorless, or faintly greenish-yellow liquid, becoming darker and thicker by age and exposure to air; having the characteristic odor of juniper, and a warm, aromatic, somewhat terebinthinate and bitterish taste. Spec. gr. 0.860 to 0.880. Soluble in 10 volumes of 90 per cent. alcohol.

Composition.—Oil of juniper is a terpene ($C_{10}H_{16}$), and is isomeric with oil of turpentine.

Dose.—H. & C., ℥ i.-ii. (4.-8.); D., ♏ii.-x. (.12-.6).

PREPARATIONS.

Spiritus Juniperi. Spirit of Juniper. (U. S. & B. P.)

Oil of Juniper, 50; alcohol, 950. (U. S. P.)

Dose.—H. & C., ℥ i.-ii. (30.-60.); D., ʒ ss.-i. (2.-4.).

Spiritus Juniperi Compositus. Compound Spirit of Juniper.

Oil of juniper, 8; oil of caraway, 1; oil of fennel, 1; alcohol, 1400; water ♁ make 2000.

Dose.—H. & C., ℥ ii.-iv. (60.-120.); D., ʒ i.-iv. (4.-15.).

ACTIONS AND USES.

Oil of juniper resembles oil of turpentine physiologically as well as chemically. It is a stomachic and carminative, particularly when combined with alcohol and other aromatic oils (sp'r. juniper. co.), but is used in medicine chiefly for its stimulant and diuretic action upon the kidneys and genito-urinary tract during its elimination. Oil of juniper is capable of irritating the kidneys in large doses, and causing congestion, strangury, and even suppression of urine. It is less likely, however, to disturb digestion than oil of turpentine, and does not so readily occasion hematuria and albuminuria. Oil of juniper is indicated in chronic nephritis, pyelitis and cystitis; also in dropsy of cardiac, renal, or hepatic origin. It is efficient in assisting absorption of effusions into serous cavities, through its diuretic properties. The compound spirit of juniper approximates gin in composition, although it is not the official name for that liquor. This preparation is useful in the convalescent period of acute bronchitis and influenza, stimulating the bronchial mucous membrane by virtue of the volatile oil, and acting as a circulatory stimulant and diuretic. The oil of juniper is an efficient renal stimulant in passive congestion of the kidneys, and following the active stage of acute nephritis.

Juniper berries are sometimes given to the larger animals on their food (℥i.-ii.), or are exhibited in infusion.

Class 5.—Used Mainly for its Emmenagogue Action on the Female Generative Organs.

Sabina. Savin. (U. S. P.)

Synonym.—Sabinæ cacumina, B. P.; savin tops, E.; sabine, Fr.; sadebaumspitzen, sevenkraut, G.; summitates (herba) sabinæ, P. G.

The tops of juniperus Sabina Linné (nat. ord. Coniferæ).

Habitat.—Canada, Northern United States, Europe and Siberia.

Description.—Short, thin, sub-quadrangular branchlets; leaves rather dark green, in four rows, opposite, scale-like, ovate-lanceolate, more or less acute, appressed, imbricated on the back with a shallow groove containing an oblong or roundish gland; odor peculiar, terebinthinate; taste nauseous, resinous and bitter. The chief constituent is the volatile oil, about 2 per cent.

Dose.—H., ʒ i.-ii. (30.-60.); D., gr. v.-xv. (.3-1.).

PREPARATION.

Fluidextractum Sabinæ. Fluidextract of Savin. (U. S. P.)

Made by maceration and percolation with alcohol, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—H. & C., ʒ i.-ii. (30.-60.); D., ♏v.-xv. (.3-1.).

Oleum Sabinæ. Oil of Savin. (U. S. & B. P.)

Synonym.—Essence de sabine, Fr.; sadebaumöl, G.

A volatile oil distilled from the fresh tops of savine.

Properties.—A colorless, yellowish liquid, having a peculiar terebinthinate odor, and a pungent, bitterish and camphoraceous taste. It becomes darker and thicker by age and exposure to the air. Spec. gr. 0.855-0.865. Soluble in one-half volume of 90 per cent. alcohol and glacial acetic acid. It is composed of several terpenes.

Dose.—H. & C., ʒ ii.-iv. (8.-15.); D., ♏i.-v. (.06-.3).

Administration.—The oil is given in capsules or pills to small animals; in emulsion with gum, or in bland oil, to the larger animals.

Action External.—The oil is a powerful irritant to the skin, producing redness, vesication and even pustulation.

Action Internal.—The oil resembles oil of turpentine, but is more irritating. Full doses cause gastric stimulation, reflex circulatory excitement, and frequent micturition. Toxic quantities occasion gastro-enteritis with vomiting (in dogs), purging, colic, pain-

ful micturition, and the passage of bloody, albuminous urine. There are also unconsciousness, stertor, rapid breathing and pulse, convulsions and collapse. Lesions of gastro-enteritis are observable after death, except in rare cases, when only congestion of the brain and lungs occur. The oil is eliminated by the skin and bronchial mucous membrane, but chiefly by the kidneys, with consequent stimulation of the genito-urinary organs. The uterus and ovaries are irritated and congestion of them follows with acceleration of ovulation. The oil also excites uterine contractions in the pregnant state. The drug is therefore an emmenagogue and ecbolic.

Uses.—The Unguentum (B. P.) may be applied externally as a counter-irritant. The oil is occasionally employed as an anthelmintic, but is inferior to other agents for this purpose. It may be given in atonic ammenorrhea, or in metrorrhagia due to uterine relaxation, with benefit, but it should be used cautiously. The oil is not to be used as an abortifacient, since sufficient doses to cause abortion will usually endanger the life of the mother or fetus, or both.

So-called Solid Volatile Oils or Stearoptens.

CAMPHORA. Camphor. $C_{10}H_{16}O$. (U. S. & B. P.)

Synonym.—Gum camphor, laurel camphor, E.; camphre, Fr.; kampfer, G.

A stearopten (having the nature of a ketone) obtained from Cinnamomum Camphora (Linné) Nees et Ebermaier (nat. ord Laurineæ), and purified by sublimation.

Habitat.—China, Japan, Cochin China and Sunda Islands.

Properties.—White, translucent masses, of a tough consistence and a crystalline structure, readily pulverizable in the presence of a little alcohol, ether, or chloroform; having a penetrating, characteristic odor, and a pungently aromatic taste. Spec. gr. 0.990. Very sparingly soluble in water, but readily soluble in alcohol, ether, chloroform, carbon disulphide, benzin, and in fixed and volatile oils, and milk. When camphor is triturated, in about molecular proportions, with menthol, thymol, phenol, or chloral hydrate, liquefaction ensues. On exposure to the air it evaporates, and when moderately heated, it sublimes without leaving a residue.

Composition.—"A stearopten is a solid crystalline substance separated from any volatile oil on long standing or at low temperature." Camphor is a stearopten and is chemically an oxidation product of a terpene (Pinene or Cymene),—the principal constituent of all volatile oils. A terpene is a hydrocarbon containing 10 atoms

of carbon, and the terpene ($C_{10}H_{16}$) from which camphor is derived is isomeric with that of oil of turpentine and many other volatile oils.

Dose.—H., 3 i.-iii. (4.-12.); C., 3 ii.-iv. (8.-15.); Sh. & Sw., gr. xv.-3 i. (1.-4.); D., gr. iii.-xx. (.18-1.3).

PREPARATIONS.

Aqua Camphoræ. Camphor Water. (U. S. & B. P.)

Triturate camphor, 8, with alcohol, 8, and purified talc, 15; then with water to make 1000. Filter. (U. S. P.)

Dose.—Ad lib.

Spiritus Camphoræ. Spirit of Camphor. (U. S. & B. P.)

Dissolve camphor, 100, in alcohol, 800; filter, and add alcohol to make 1000. (U. S.)

Dose.—H. & C., ʒ i.-ii. (30.-60.); D., 3 ss.-i. (2.-4.).

Linimentum Camphoræ. Camphor Liniment. (U. S. & B. P.)

Synonym.—Camphorated oil.

Camphor, 200; cottonseed oil, 800. (U. S. P.)

Dose.—H. & C., ʒ ss.-i. (15.-30.); D., ♏x.-xv. (0.6-1.)

Ceratum Camphoræ. Camphor Cerate. (U. S. P.)

Camphor liniment, 100; white petrolatum, 150; white wax, 350; lard, 400.

Tinctura Camphoræ Composita. (B. P.) (Paregoric.)

Contains 1 part of morphine in 2000 = gr.¼ opium in 3 i. paregoric.

Dose.—D., 3 ss.-i.

Camphora Monobromata. Monobromated Camphor. $C_{10}H_{15}BrO$. (U. S. P.)

Derivation.—Made by heating camphor and bromine together at a temperature of 172°F. (77.7°C.) and solution in benzin. $C_{10}H_{16}O + 2\ Br = C_{10}H_{15}Br\ O + H\ Br$. Recrystallized from hot alcohol.

Properties.—Colorless, prismatic needles or scales, having a mild, camphoraceous odor and taste; permanent in the air, unaffected by light, and neutral to litmus paper. Almost insoluble in water; freely soluble in alcohol, ether, and chloroform, hot benzin and fixed and volatile oils; slightly soluble in glycerin.

Dose.—D., gr.ii.-x. (.12-.6).

Action External.—Camphor resembles the volatile oils chemically and physiologically. It is a slight antiseptic externally, and parasiticide. The vapor of camphor kills moths, fleas, bugs, etc. Camphor is a mild irritant, producing a rubefacient action followed

by partial anesthesia. It is eliminated in part by the skin and occasions some diaphoresis.

Action. Internal.—Alimentary Canal.—Camphor stimulates the stomach, increasing the secretion, motion and vascularity of the organ. In the bowels camphor is supposed to overcome pain, spasm, and check secretion in diarrhea, but has little effect in normal conditions and in therapeutic doses.

Circulation.—The frog's heart is stimulated by camphor, and the pulse is slowed and increased in force by moderate doses. The drug acts in part directly on the heart muscle and in part reflexly from irritation of the stomach. While animal experiments do not show that camphor has any material effect on the heart in ordinary doses yet clinical experience has proved that it does stimulate the circulation in conditions of general depression of the circulation from acute illness, in poisoning and after surgical operations. Moreover, when ingested, camphor stimulates the heart reflexly by irritation of the stomach, as in the case of alcohol.

Animal experiments do show that it sometimes first stimulates and then depresses the vasomotor centres in large doses, producing a corresponding effect on blood pressure. Poisonous quantities of camphor depress the heart and the pulse becomes feeble and rapid. Leucocytosis is favored by camphor.

Respiration.—Camphor does not influence the respiration materially in therapeutic doses. Occasionally the respiration is made slower and deeper. Camphor, like volatile oils, stimulates the bronchial mucous membranes in its elimination by the lungs, and increases the blood supply and secretion of these parts. The characteristic odor is imparted to the breath after the ingestion of camphor. The drug is believed to relieve spasm and cough in bronchitis.

Nervous System.—Camphor is often classed as an antispasmodic. It stimulates the nerve centres in the brain, medulla, and spinal cord, and thus overcomes spasm due to nervous weakness and incoördination. Poisonous doses depress and paralyze the higher nervous centres.

Kidneys and Sexual Organs.—Camphor is oxidized in the body into camphorol ($C_{10}H_{16}O_2$) and eliminated in the breath and sweat, but mainly in the urine, as camphoglycuronic acid. The drug influences the sexual organs, in some cases, but in most instances does not affect them. Full medicinal doses sometimes stimulate the sexual functions (aphrodisiac action). Very large doses are said to depress sexual desire (anaphrodisiac action), but these quantities may irritate the genito-urinary tract and produce erotic excitement.

Temperature.—Camphor is a slight antipyretic.

Toxicology.—Two to four ounces of camphor given to horses

or cattle induce delirium and convulsions (cerebral stimulation) with rapid pulse and breathing, but usually recovery ensues. Two to four drachms cause, in dogs, vomiting, unsteady movements, asphyxia, coma (cerebral depression) and death from respiratory failure.

Administration.—Camphor is exhibited internally in the form of the spirit, in pill or ball; and in solution in oil or milk.

Uses External.—Camphor is applied in powder as a stimulant and antiseptic on indolent sores; mixed with chalk or zinc oxide, as a dusting powder, in chafing or erythema, for its anesthetic properties. It is employed in liniments (Lin. Saponis, Lin. Camphoræ), in strains, bruises, rheumatism and myalgia, as a rubefacient and local anodyne.

Uses Internal.—Camphor is a valuable agent in stimulating the vital nerve centres in depression, collapse and shock and also, in less degree, the circulation.

In poisoning by alcohol, opium, belladonna, etc., and post-operative shock and collapse it has the highest reputation with leading surgeons and clinicians. It should be given subcutaneously dissolved in almond, olive or cottonseed oil in the proportion of the linimentum camphorae (U. S. P.), that is 1 to 4. The oil should be first sterilized by boiling.

℞

Camphoræ ..... 3 i.

Olei olivæ..... 3 iv.

M.

Sig. Inject as one dose subcutaneously (Horses).
Inject m. xv for dogs. Repeat hourly.

The effect of these injections is to produce some induration and not more than 1½ drams should be injected at one point.

Camphor is of benefit in exhausting acute diseases (influenza, pneumonia and canine distemper), for the same reason, and because it possesses diaphoretic and antipyretic properties. It may be combined with alcohol, spirit of nitrous ether, and ammonia compounds, in these affections.

Respiratory disorders are improved by camphor, since it is an expectorant, diaphoretic, stimulant and antiseptic. It is prescribed in spasmodic cough, bronchitis and pharyngitis. For the latter, in electuary with belladonna.

Camphor is a valuable drug in diarrhea, particularly in the serous variety, and in that form following exposure to cold. It is not useful in inflammatory conditions, but checks secretion and pain. Camphor is prescribed alone in diarrhea, or with brandy and laudanum.

Camphor is sometimes given as an antispasmodic in hysteria and "thumps" (spasm of diaphragm) of horses; and in nervous palpitation of the heart, and chorea (monobromated camphor) of dogs.

Spirit of camphor and nitrous ether are efficient in relieving irritation of the genito-urinary tract. Camphor has proven of service in purpura hemorrhagica of horses given thrice daily in pills (gr. 75).

Thymol. Thymol. $C_{10}H_{14}O$. (U. S. & B. P.)

A phenol (or stearopten, B. P.) occurring in the volatile oils of Thymus Vulgaris Linné, and in other volatile oils.

Habitat.—Thymus vulgaris, Southern Europe, cultivated.

Derivation.—Thymol is made from the terpenes of the volatile oils mentioned above, by fractional distillation and saponifying the result with caustic soda to remove more terpenes, and by cooling. The resulting soap, or soda-thymol compound is decomposed with hydrochloric acid, and thymol is crystallized from an alcoholic solution.

Properties.—Large, colorless, translucent crystals of the hexagonal system, having an aromatic, thyme-like odor, and a pungent, aromatic taste, with a very slight caustic effect upon the lips. Its specific gravity, as a solid, is 1.030, but when liquefied by fusion it is lighter than water. It melts at 50° to 51° C. (122° to 123.8° F.), remaining liquid at considerably lower temperatures. When triturated with about equal quantities of camphor, menthol, or chloral, it liquefies.

Soluble in about 1100 parts of water, and in less than its own weight of alcohol, ether or chloroform; also readily soluble in carbon disulphide, glacial acetic acid, and in fixed or volatile oils.

Dose.—H., 3 ss.-ii. (2.-8.); Sh. (single dose), 3 ss.-ii.ss.; D., gr. i.-xv. (.06-1.).

Action and Uses.—Thymol resembles carbolic acid chemically and physiologically. It is less poisonous and irritant, more costly, and possesses greater antiseptic powers. It is much less valuable, however, medicinally, on account of its expense, and odor which strongly attracts flies.

Poisoning is not produced readily, as absorption from the digestive tract is slow; but after considerable doses by the mouth, or when injected into the blood, toxic symptoms occur. One drachm given intravenously to a dog caused prostration, coma and respiratory failure. Recovery ensued after the use of artificial respiration. Often no lesions are discoverable after death. At other times there is hyperemia of the lungs and kidneys caused by elimination of the

drug. The urine is colored greenish or yellowish-brown by transmitted light.

Thymol is used externally for general antiseptic purposes, for application to ulcers, and as an injection in cystitis in aqueous saturated solution. It is employed in ointment with vaseline (1-15) to destroy ringworm and to relieve itching in pruritus, eczema, lichen, psoriasis, etc. It may be applied as follows for the same purposes:

℞

Thymol	gr.xv.
Alcohol	ʒ ii. ss.
Glycerin	ʒ v.
Aq. ad	Oi.

M.

An efficient antiseptic mouth wash consists of borax, gr. 40; thymol, gr. 20; water, ℥ iv. It is indicated in stomatitis. Thymol internally is a powerful anthelmintic and parasiticide. It is employed as an intestinal antiseptic; as a remedy for tape and round worm (uncinariasis in dogs), in goitre, and as a urinary antiseptic in cystitis. It is given in diluted alcoholic solutions; better in oil or capsules. As a vermifuge full doses (D., gr. x.-xxx.) should be preceded and followed by a purge, but not oil which acts as a solvent.

SECTION X.—VEGETABLE BITTERS.

Gentiana. Gentian. (U. S. P.)

Synonym.—Gentianæ radix, B. P.; radix gentianæ rubræ (vel lutæ vel majoris), gentian root, E.; radix gentianæ, P. G.; racine de gentiane (de gentiane jaune), Fr.; enzianwurzel, bitterwurzel, rother (gelber) enzian, G.

The root of Gentiana lutea Linné (nat. ord. Gentianeæ).

Habitat.—The yellow gentian is indigenous in the Alps and mountains of southern and central Europe.

Description.—In nearly cylindrical pieces or longitudinal slices, of variable length and from 5 to 35 Mm. thick; externally yellowish-brown, the rhizome annulate, the roots longitudinally wrinkled; fracture short but uneven, the bark rather thick, separated from the somewhat spongy, reddish-yellow or brownish inner portion by a dark brown cambium zone; odor strong, characteristic; taste slightly sweetish, strongly and persistently bitter.

Constituents.—The chief one is (1) gentiopicrin (may be split into gentigenin and glucose), a bitter crystalline glucoside, soluble in alcohol and water. There is also (2) gentisic acid ($C_{14}H_{10}O_5$), combined with gentiopicrin and gum, and (3) a trace of volatile oil; (4) gentigenin, a sugar. Contains no tannin.

Incompatibles.—Iron in solution forms a black compound with the coloring matter in gentian. Silver nitrate and lead salts are incompatible with gentian.

Dose.—H., ℥ ss.-i. (15.-30.); C., ℥ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. v.-xxx. (.3-2.).

PREPARATIONS.

Extractum Gentianæ. Extract of Gentian. (U. S. & B. P.)

Made by maceration and percolation with water, and evaporation to a pilular consistence.

Dose.—About one-third that of gentian.

Fluidextractum Gentianæ. Fluidextract of Gentian. (U. S. P.)

Made by maceration and percolation with diluted alcohol, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—Same as gentian.

Tinctura Gentianæ Composita. Compound Tincture of Gentian. (U. S. & B. P.)

Gentian, 100; bitter orange peel, 40; cardamon, 10; made by maceration and percolation with alcohol and water, to 1000. (U. S. P.)

Dose.—H. & C., ℥ i.-iv. (30.-120.); D., ʒ i.-iv. (4.-15.).

Administration.—Gentian is usually given to horses, cattle and sheep in powder, or to the former in the form of the compound tincture. The extract is suitable for dogs when exhibited in pills. Gentian is often employed as an excipient in the preparation of balls.

Action.—The simple bitters, as gentian, act as stomachic and bitter tonics. They are stomachics in promoting gastric digestion by stimulation of the gustatory nerves, thus improving the appetite and reflexly causing dilatation of the blood vessels in the stomach and increasing salivary and gastric secretions. Furthermore, the bitters excite gastric and intestinal peristalsis to a slight extent. The bitters only act as tonics by their local effect in facilitating the digestion and assimilation, and by increasing the appetite. Externally the bitters are mildly antiseptic; while internally they are inimical to intestinal parasites.

Uses.—Gentian is serviceable in simple loss of appetite. It is especially indicated in feeble gastric digestion caused by acute dis-

ease, overwork, insufficient and poor food, and in that form associated with general debility and anemia. In the latter state, characterized by a pasty tongue, anorexia, rough coat and pallid mucous membranes, which may often be co-existent with the presence of intestinal worms, powdered gentian is most efficient when given to horses on the food three times daily with dried ferrous sulphate.

Again, loss of appetite, general weakness, and feeble digestion occurring in horses during convalescence from acute diseases, as influenza and pneumonia, is favorably met by a combination of compound tincture of gentian and whisky (1 ounce each), or by diluted hydrochloric acid and the compound tincture. The drug is useful in atonic indigestion, or mild chronic gastric or intestinal catarrh of young animals, when conjoined with sodium bicarbonate, which acts as a sedative and solvent of mucus.

The simple bitters, including gentian, are contra-indicated in any acute inflammation of the digestive tract, since they are mild irritants. Gentian is a valuable bitter for cattle and sheep, but quinine is more commonly given to dogs.

Quassia. Quassia. (U. S. P.)

Synonym.—Quassiæ lignum, B. P.; quassia wood, bitter wood, bitter ash, E.; quassie, bois amer, Fr.; quaissienholz, G.

Habitat.—Jamaica and West Indies.

Description.—The wood of *Picrasma excelsa* (Swartz) Planchon (Fam. *Simarubaceæ*), known commercially as Jamaica Quassia, or of *Quassia amara* Linné (Fam. *Simarubaceæ*), known commercially as Surinam Quassia.

Jamaica Quassia.—Occurring in various forms, usually in chips, raspings, or billets; yellowish-white or pale yellow, and of rather coarse texture; odor slight; taste intensely bitter; medullary rays containing tetragonal prisms or small, arrow-shaped crystals of calcium oxalate. Billets of Jamaica Quassia are usually 12.5 Cm. or more in diameter; in tangential section, the medullary rays are mostly 3 to 5 rows of cells in width.

Surinam Quassia.—Occurring usually in billets not exceeding 7.5 Cm. in diameter; the wood is heavier, harder, and more deeply colored than that of Jamaica Quassia, and the medullary rays in tangential section are mostly 1 or 2 rows of cells in width.

Constituents.—Chiefly, quassiin ($C_{10}H_{12}O_5$), a bitter, neutral principle occurring in crystalline rectangular plates. There is also a volatile oil, but no tannin.

Dose.—Quassiin, D., gr. ⅛-⅓ (.008-.02).

PREPARATIONS.

Extractum Quassiæ. Extract of Quassia. (U. S. & B. P.)

Made by percolation with water, boiling and evaporation to pilular consistence.

Dose.—H., ʒ i.-ii. (4.-8.); D., gr.ss.-iii. (.03-.18).

Fluidextractum Quassiæ. Fluidextract of Quassia. (U. S. P.)

Made by maceration and percolation with alcohol and water, and evaporation, so that 1 Cc. = 1 Gm. of quassia.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ ii.-iv. (8.-15.); D., ♏xv.-ʒ i. (1.-4.).

Tinctura Quassiæ. Tincture of Quassia. (U. S. & B. P.)

Made by maceration and percolation of quassia, 200, with alcohol and water to make 1000. (U. S. P.)

Dose.—Twice that of fluidextract.

Liquor Quassiæ Concentratus. (B. P.)

Dose.—Same as for fluidextract.

Administration.—Quassia may be given to horses in the official preparations,—preferably the fluidextract,—or in infusion (1-80, in cold water for half an hour, B. P.). The dose of the infusion is ℥ iv. for horses, ʒ ii.-iv. for dogs.

Actions.—Quassia is the most active and bitter stomachic we possess. Large doses irritate the digestive tract. The drug is poisonous to the lower forms of animal life. One grain will kill a frog with the production of convulsions and respiratory and heart failure. A sweetened infusion is often employed to destroy flies. Considerable doses of quassia increase the secretion of urine, and stimulate peristaltic action and contraction of the urinary bladder. It is an antiseptic and prevents fermentation in the digestive canal. Quassia acts generally in the same manner as gentian, by sharpening the appetite, and increasing salivary and gastric secretions, together with vascularity and peristalsis of the stomach. The volatile oil assists the stomachic action.

Uses.—Quassia, like gentian, is very serviceable in promoting appetite and digestion in atonic dyspepsia. It has this advantage, however, that it may be combined with liquid preparations of iron without incompatibility. Quassia is the most efficient vermicide in our possession for the destruction of Oxyuris curvula, horse; and O. vermicularis, dog, in the lower bowel. An infusion is employed for this purpose, made by soaking quassia chips in cold water (ʒ ii.-Oi.) for half an hour. The rectum should be first thoroughly washed

out with soap and water, and one-half pint of this infusion is given in enema to dogs; two quarts to horses.

Calumba. Calumba. (U. S. P.)

Synonym.—Calumbæ radix, B. P.; columbo, E.; columbo, Fr.; kolumbowurzel, G.

The root of Jateorhiza palmata (Lamarck) Miers (nat. ord. Menispermaceæ).

Habitat.—Mozambique, East Africa. Cultivated in the East Indies.

Description.—In transverse, circular or oval, biconcave sections, 2.5 to 5 Cm. in diameter and 2 to 12 Mm. thick; externally greenish-brown and roughly wrinkled; internally yellowish or grayish-yellow, with a few interrupted circles of fibrovascular bundles, distinctly radiate in the outer portion, with a dark cambium; fracture short, mealy; odor slight; taste slightly aromatic, very bitter.

Constituents.—1, columbin ($C_{21}H_{22}O_7$), a neutral bitter, crystalline substance; 2, an alkaloid, berberine ($C_{20}H_{17}NO_4$), found in berberis, hydrastis, etc.; 3, columbic acid ($C_{21}H_{22}O_6$); 4, starch, 33 per cent.

Dose.—H. & C., ʒ ss.-i. (30.-60.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. v.-xxx. (.3-2.).

PREPARATIONS.

Fluidextractum Calumbæ. Fluidextract of Calumba. (U. S. P.)

Made by maceration and percolation with alcohol and water, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug. (U. S. P.)

Dose.—Same as Calumba.

Tinctura Calumbæ. Tincture of Calumba. (U. S. & B. P.)

Made by maceration and percolation of calumba, 200, in alcohol, and water to make 1000. (U. S. P.)

Dose.—H. & C., ʒ ii.-iv. (60.-120.); D., ʒ i.-iv. (4.-15.). Dose of tincture (B. P.) half that of U. S. P. tincture.

Administration.—Calumba is given in powder on the food, or in the official preparations to the larger animals. The infusion (1-16, B. P.) may be used in the same doses as that of cascarilla. The tincture, and extract (gr. ii.-x., B. P.) are the best preparations for dogs.

Actions and Uses.—Calumba is a mild but pure bitter. Berberine, calumbin and calumbic acid are all bitter, but none of them

possess any powerful physiological action. Calumba is indicated in the same cases as gentian, but, being free from tannin, may be combined with iron preparations without producing an unsightly, inky mixture. It is less irritating than other bitters, and may be prescribed in more irritable conditions of the stomach. Calumba is frequently used during convalescence from the acute diseases and diarrhea.

Taraxacum. Taraxacum. (U. S. P.)

Synonym.—Taraxici radix, B. P.; dandelion, E.; pissenlit, dent de lion, Fr.; löwenzahn, G.

The dried root of Taraxacum officinale Weber (nat. ord. Compositæ), gathered in autumn.

Habitat.—Naturalized in the United States and growing commonly in waste places. Indigenous in Europe.

Description.—Cylindraceous and tapering very gradually, of variable length, and 1 to 2 Cm. thick above, crowned with several short, thickish heads, usually simple or somewhat branched, the branches closely parallel; externally blackish-brown, longitudinally wrinkled; fracture short, showing a yellowish, porous central axis, surrounded by a thick, whitish bark, containing numerous milk vessels arranged in concentric circles; inodorous; bitter.

Constituents.—1, taraxacin, a bitter, soluble, crystalline substance; 2, inulin; 3, taraxacerin ($C_8H_{16}O$); 4, resin, causing the milky juice; 5, asparagin, of no medicinal value.

Dose.—H., ʒi.-ii. (30.-60.); Sh. & Sw., ʒ ii.-iv. (8.-15.); D., ʒ i.-ii. (4.-8.).

PREPARATIONS.

Extractum Taraxaci. Extract of Taraxacum. (U. S. & B. P.)

Made by percolation of powdered taraxacum, 1000; with alcohol and water, 1000; and evaporation to pilular consistence.

Dose.—H. & C., ʒ i.-iv. (4.-15.); D., gr.v.-xx. (.3-1.3.).

Fluidextractum Taraxaci. Fluidextract of Taraxacum. (U. S. P.)

Made by maceration and percolation with diluted alcohol, and evaporation, so that 1 cc. = 1 gm. of taraxacum.

Dose.—Same as taraxacum.

Extractum Taraxici Liquidum. (B. P.)

Dose.—Same as taraxacum.

Administration.—The fresh juice squeezed from the root (succus, B. P.) may be given to horses; or the official preparations may be used.

Action and Uses.—Taraxacum is a simple stomachic and bitter and may be employed in place of gentian or calumba. It has been generally taught that taraxacum is an hepatic stimulant and increases the secretion of bile. This has been proved fallacious. The extract is often used as an excipient in preparing masses.

Hydrastis. Hydrastis. (U. S. P.)

Synonym.—Hydrastis rhizoma, B. P.; golden zeal, yellow root, yellow puccoon, orange root, Indian dye, Indian tumeric, E.; racine d'hydrastis de Canada, Fr.; Canadische gelbwürzel, G.

The rhizome and roots of Hydrastis canadensis Linné (nat. ord. Ranunculaceæ), yielding not less than 2.5 per cent. of hydrastine.

Habitat.—North America in woods, west to Missouri and Arkansas.

Description.—Rhizome of oblique growth, subcylindrical, straight or somewhat tortuous, 2 to 5 Cm. long, and 3 to 6 Mm. in diameter, with short stem remnants, or stem scars, and slightly annulate; externally brownish-gray to yellowish-brown; fracture short, waxy, deep yellow; bark about 0.5 Mm. thick, wood wedges bright yellow, pith large, light yellow; the roots thin, brittle, with a thick yellow bark and a somewhat quadrangular wood; odor distinct; taste bitter.

Constituents.—1, berberine ($C_{20}H_{17}NO_4$), an alkaloid occurring in yellow crystals and found in many plants of the families Berberaceæ, Ranunculaceæ, and Menispermaceæ; 2, hydrastine ($C_{21}H_{21}NO_6$), a colorless, crystalline alkaloid, soluble in alcohol and ether; 3, canadine ($C_{21}H_{21}NO_4$), occurring in white, acicular crystals.

Dose.—H. & C., ʒ ii.-ʒ i. (8.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. v.-ʒ i. (.3-4.).

PREPARATIONS.

Fluidextractum Hydrastis. Fluidextract of Hydrastis. (U. S. P.)

Made by maceration and percolation with alcohol, glycerin and water, and evaporation. Assayed and enough menstruum added so that it will contain 2 per cent. of hydrastine.

Dose.—H. & C., ʒ ii.-ʒ i. (8.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., ♏v.-ʒ i. (.3-4.).

Extractum Hydrastis Liquidum. (B. P.)

Dose.—H. & C., ʒ i.-iii. (4.-12.); D., ♏v.-xv. (.3-1.).

Tinctura Hydrastis. Tincture of Hydrastis. (U. S. & B. P.)

Made by maceration and percolation of hydrastis, 200; with diluted alcohol, to 1000.

Dose.—H., ʒ i.-ii. (30.-60.); D., ʒ ss.-ii. (2.-8.).

Glyceritum Hydrastis. Glycerite of Hydrastis. (U. S. P.)

Made by maceration and percolation of hydrastis, 1000; add water to the percolate and evaporate. Add water to the residue, set aside 24 hours and filter; add enough water to the filtrate to make 500; then add glycerin, 500.

Dose.—Same as fluid extract.

Hydrastinæ Hydrochloridum. Hydrastine Hydrochloride. $C_{11}H_{11}NO_2H$ Cl. (U. S. P.)

The hydrochloride of an artificial alkaloid derived from hydrastine.

Properties.—Light, yellow, amorphous granules, or a pale yellow crystalline powder; odorless, and having a bitter, saline taste; deliquescent on exposure to damp air. Very soluble in cold and hot water, and in alcohol.

Dose.—H., gr. i.-ii. (.06-.12); D., gr. $\frac{1}{12}$-$\frac{1}{6}$ (.005-.01).

Hydrastin. (Non-official).

The commercial name for a mixture of variable composition, consisting chiefly of berberine, together with hydrastine, and a resin. A greenish-yellow powder, having a bitter taste. Wrongly termed hydrastine.

Dose.—H., gr. xv.-xxx. (1.-2.); D., gr. iii.-v. (.18-.3).

Actions.—Hydrastis and its alkaloids, berberine and hydrastine, act as simple bitters and stomachics, in small doses, by improving the appetite and stimulating the secretion, motion and vascularity of the stomach. Hydrastis causes contraction of the non-pregnant uterus, and may induce abortion in pregnant animals. It also increases the flow of urine. The drug is a mild anti-periodic, but is decidedly inferior to quinine in this respect. Hydrastine and berberine resemble each other in actions, uses and doses. Berberine sulphate and hydrastine hydrochloride are to be found in the market, and are used in the same doses as the pure alkaloids. Poisonous doses of hydrastine and berberine are followed by convulsions and paralysis; the former is more convulsant. Hydrastine is said primarily to markedly increase vascular tension. It is uncertain whether this action is due to vascular contraction or cardiac stimula-

tion. In poisoning by either alkaloid there is great cardiac and vasomotor depression.

Uses.—Hydrastis, berberine, and hydrastine are employed in anorexia and atonic indigestion. The fluidextract of hydrastis and hydrastine (both, however, are very expensive) are especially efficient for horses in combination with other bitters and iron, as follows:

℞
Fluidextr. Capsici..... ʒ ii.
Fluidextr. Hydrastis.
Fluidextr. Nucis Vomicæ.....āā ʒ iii.
M. (Furnish ʒ ii. bottle)
Sig. Small bottleful tid. on tongue.

or:—

℞
Hydrastinæ .....gr.xxx.
Pulv. Gentianæ
Pulv. Nucis Vomicæ
Ferri Sulph. Exsicc.....āā ʒ ii.
M. et div. in ch't, no. xii.
Sig. One powder on food tid.

Hydrastis is exhibited empirically (probably as a local stimulant and antiseptic) in atonic and inflammatory conditions of the digestive organs, with great benefit, as in chronic gastro-intestinal catarrh or catarrhal jaundice. Hydrastis is used most frequently in human medicine to stop uterine hemorrhage of all descriptions, and is often conjoined with the fluid extract of ergot for this purpose. Hydrastinine hydrochloride has been employed with great success as a hemostatic in metrorrhagia. Hydrastine is given to horses as a bitter tonic in doses of gr. iii.-v.; and to dogs in quantities of gr. ¼-½. Externally, the fluidextract of hydrastis (1-8 to 1-2), or hydrastine (gr. v.-ʒ i.), in aqueous solution, are most serviceable as local stimulants in the treatment of the subacute stages in inflammatory diseases of mucous membranes, and in relaxed or atonic conditions of these tissues. The solutions are applied as injections, or lotions, in leucorrhea, endometritis, balanitis, otorrhea, stomatitis, etc., and upon indolent ulcers.

Calamus. Calamus. (U. S. P.)

Synonym.—Sweet flag, radix acori, E.; rhizoma calami, P. G.; acore vrai, acore odorant, Fr.; kalmuswurzel, G.

The unpeeled, dried rhizome of Acorus Calamus Linné (nat. ord. Aroideæ.)

Description.—Rhizome 1 to 2 Cm. thick, usually in longitudinally split pieces of various lengths; when entire, cylindraceous and somewhat vertically flattened, externally reddish-brown, somewhat annulate from remnants of leaf-sheaths; upper surface with triangular leaf-scars, the lower surface with circular pitted scars of roots; fracture short, showing numerous oil-cells and scattered fibrovascular bundles, the latter crowded within the endodermis; odor aromatic; taste pungent and bitter.

Constituents.—1, acorin ($C_{36}H_{60}O_6$), a liquid, yellow glucoside having a bitter taste; 2, a volatile oil, 1-2 per cent.; 3, calamine; 4, choline.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-iii. (4.-12.); D., gr. xv.-ʒ i. (1.-4.).

PREPARATION.

Fluidextractum Calami. Fluidextract of Calamus. (U. S. P.)

Made by maceration, percolation and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—H. & C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-iii. (4.-12.); D., ♏xv.-ʒ i. (1.-4.).

The powdered root may be given on the food to the larger animals; the fluidextract, or an infusion (1-16), may be exhibited to any patients.

Action and Uses.—Calamus is a mild aromatic bitter, and is therefore useful in anorexia and indigestion associated with mild forms of flatulence. The powdered root is employed as an excipient in powders, balls and electuaries. It is innocuous, and the dose is therefore unimportant.

SECTION XI.—VEGETABLE CATHARTICS.

Class 1.—Simple Purgatives.

ALOE. Aloes. (U. S. P.)

(ALOE BARBADENSIS, ALOE SOCOTRINA, PHARM. 1890.)

The inspissated juice of the leaves of *Aloe vera* (Linné) Webb, *Aloe Chinensis* Baker, *Aloe Perryi* Baker, or other species of *Aloe* (Fam. *Liliaceæ*).

Properties.—In yellowish-brown or orange-brown to blackish-

brown opaque masses; translucent in thin fragments; fracture uneven, dull and waxy, somewhat resinous, or smooth and glassy, somewhat conchoidal; occasionally exhibiting microscopic crystals of aloin; odor characteristic; taste nauseous, bitter.

Aloe Barbadensis. Barbadoes Aloes. (B. P.)

Synonym.—Curacoa aloes, E.; aloés des Barbades, Fr.; Barbados-aloe, G.

The inspissated juice of the leaves of Aloe vera (Linné) Webb (nat. ord. Liliaceæ).

Habitat.—The island of Barbadoes.

Properties.—In hard masses, orange-brown, opaque, translucent on the edges; fracture waxy or resinous, somewhat conchoidal; odor saffron-like; taste strongly bitter. Almost entirely soluble in alcohol.

Aloe Socotrina. Socotrine Aloes. (B. P.)

Synonym.—Aloe succotrina, aloés sucotrin, s. socotrin, Fr.; socotora s. socotrinische aloe, G.

The inspissated juice of the leaves of Aloe Perryi Baker (nat. ord. Liliaceæ).

Habitat.—Eastern Africa.

Properties.—In hard masses, occasionally soft in the interior; opaque, yellowish-brown, orange-brown, or dark ruby-red, not greenish, translucent on the edges; fracture resinous, somewhat conchoidal. When breathed upon, it emits a fragrant saffron-like odor; taste peculiar, strongly bitter. Almost entirely soluble in alcohol and in 4 parts of boiling water. The aqueous solution becomes turbid on cooling and yields a deposit.

The color of socotrine aloes is lighter, and it is less opaque than Barbadoes aloes. The powdered socotrine aloes is brighter and redder, and the odor less disagreeable than that of Barbados aloes.

Aloe Capensis. Cape Aloes. (Non-official.)

Synonym.—Aloés der Cap, Fr.

Habitat.—Africa.

Properties.—Occurs in dark-brown or olive-green resinous masses; fracture conchoidal; odor strong, sour and disagreeable. Yields a gamoge-yellow powder. Solubility same as socotrine aloes. Product of several varieties of aloes obtained from Cape Town and Natal.

Dose of Aloes.—H., ℥ ss.-i. (15.-30.); C., ℥ i.-ii. (30.-60.); Sh., ℥ ss.-i. (15.-30.); Sw., ʒ ii.-iv. (8.-15.); D., gr. xx.-ʒ i. (1.3-4.).

Constituents.—1, aloin; 2, a resin; 3, a volatile oil, giving the odor; 4, a trace of gallic acid.

Aloinum. Aloin. (U. S. & B. P.)

Synonym.—Alöine, Fr.

A neutral principle obtained from several varieties of aloes, chiefly from Curaçoa aloes and Barbadoes aloes (yielding Barbaloin), and Socotra or Zanzibar aloes (yielding Socaloin), differing more or less in chemical composition and physical properties according to the source from which it is derived.

Derivation.—Obtained by pulverizing and macerating Barbadoes aloes in cold water, and evaporating the resulting solution in vacuo. Aloin crystallizes out and is dried between folds of bibulous paper. It is purified by repeated solution in hot water, filtration, recrystallization, and finally by solution in hot alcohol and crystallization. Nataloin is derived from Cape aloes.

Properties.—A micro-crystalline powder or minute acicular crystals, lemon yellow to dark yellow in color, possessing a slight odor of aloes and an intensely bitter taste. It is slightly hygyroscopic. Aloes from Curaçoa aloes is soluble in about 65 parts of water and 10.75 parts of alcohol. Barbaloin and socaloin are soluble in about 60 parts of cold water. Barbaloin is soluble in 20 parts of alcohol. Socaloin in 30 parts of absolute alcohol.

Dose.—H. & C., ʒ ii.-iii. (8.-12.); D., gr. ii.-xx. (.12-1.3), in combination with other purgatives.

PREPARATIONS OF ALOES.

The official preparations are numerous, but most are not applicable to veterinary practice.

Tinctura Aloës et Myrrhæ. Tincture of Aloes and Myrrh. (U. S. P.)

Synonym.—"Elixis pro," elixir proprietas Paracelsi, E.

Made by maceration and percolation of purified aloes, 100; myrrh, 100; and liquorice root, 100; with alcohol and water to make 1000.

Pilulæ Laxativæ Compositæ, U. S. P. Aloin 1.3 gm.; strychnine, 0.05 gm.; extr. belladonna leaves, 0.8 gm.; ipecac, 0.4 gm.; glycyrrhiza, 4.6 gm.; syrup q. s. to make 100 pills. Dogs. Dose, 1 to 2 pills.

Action External.—Aloes is a slight stimulant to raw surfaces. It is absorbed from the denuded skin and thus may occasion purging.

Action Internal.—Alimentary Canal.—Aloes is first of all a purgative. In addition to this it is a bitter, and therefore small doses excite salivary and gastric secretion, together with the movements and vascularity of the stomach, and appetite. The activity of aloes in the bowels is due largely to the solvent action of bile upon it. Aloes is absorbed from the digestive tract and is eliminated by the bowels, kidneys and mammary glands. It may be excreted in sufficient quantity in the milk to create looseness of the bowels in nursing animals.

Aloes stimulates peristalsis of the large intestines, but does not notably increase the secretions of the bowels. Moreover, its action is very slow (12-24 hours). This probably happens because the drug does not act till it reaches the large intestines, locally, or through elimination. Aloes is preëminently the best purgative for horses, but does not operate so well on the other domestic animals. Epsom salts, glauber salts or linseed oil are preferable for cattle; linseed oil or carron oil for foals and calves; and castor oil or calomel for dogs. In chronic constipation in dogs cascara sagrada, phenolphthalein and aloes are, however, effective (see below). A full dose of aloes often creates some general disturbances in horses, including nausea, slight colic, diuresis, elevation of temperature (1°-2° F.) and pulse, with purging lasting from 2 or 3 to 24 hours. Aloes also possesses anthelmintic properties because of its bitter qualities and purgative action. Socotrine aloes may be used in the official preparations, but Barbadoes aloes finds most favor in veterinary medicine, and is probably the stronger of the two. Cape aloes is a little inferior to the other varieties and is more apt to produce diuresis. Aloes and aloin lead to catharsis, whether injected under the skin, into the blood, or applied on raw surfaces. Administration by the mouth is more effective. Aloin appears to contain the active principles of aloes, and is usually as operative, but some manufactures are ineffective.

Kidneys and Sexual Organs.—Aloes causes reflex, or sympathetic irritation of the female pelvic organs in its operation on the lower bowel; is an emmenagogue, and may prove abortifacient. The drug sometimes excites diuresis.

Administration.—Aloes is given to horses in semi-solution after being rubbed up with hot (115°-120° F.) water; or in ball. The patient should, if possible, be previously prepared by a diet of bran mashes and salt only, for 2 or 3 feedings before exhibition of the purge. An effective aloes ball is made by melting and mixing Barbadoes aloes (1 lb.) with glycerin and molasses (each ℥ ii.), and powdered ginger root (℥ i.), on a water bath. When the mass is properly mixed it is removed from the fire and alcohol (℥ v.) is

added. The mass is poured on a layer of flaxseed meal to cool, and then is weighed into portions of 3 10½ each. These are rolled into balls, covered with tissue paper, and preserved in tight tin or glass vessels. Horses should not be worked after receiving aloes balls, but should be given a little walking exercise 12 hours after the administration of the dose. Colic and superpurgation may follow if the dose is repeated within 48 hours, or if large quantities of cold water are allowed during the action of the cathartic. If aloes does not operate satisfactorily, it is safer to give linseed oil by the mouth and rectal injections, than to administer a second dose of aloes.

Uses External.—The tincture of aloes and myrrh is sometimes applied as a stimulant to wounds, and powdered aloes is mixed with plaster of Paris in making splints for dogs, to prevent these animals from biting and tearing them off.

Uses Internal.—Aloes is employed in the treatment of the horse, whenever an active purge is desirable, with the following exceptions: It must not be used in acute diseases of the respiratory tract lest metastasis occur, and the inflammation attack the bowels. Neither in acute inflammation of the alimentary canal nor the kidneys is it desirable; nor in intestinal obstruction or impaction of the colon. In the first two named conditions, aloes is too irritating to the organs implicated; in the two last, the drug may aggravate the trouble by the production of impotent peristaltic movements. Pregnancy contra-indicates the use of aloes, lest abortion ensue. The therapeutic scope of aloes being large, it is impossible to enumerate all the diseases in which it is useful. Perhaps this cathartic is more commonly serviceable in indigestion and spasmodic or flatulent colic.

In acute inflammatory diseases of the brain and cord aloes is often combined with calomel (3 i.) in ball to enhance the effect. The administration of an aloes ball is followed by that of small doses of Epsom salts (℥ iv.) in the drinking water in the treatment of hemoglobinemia of horses, or in conditions when we wish to assist the depleting action of aloes. Turpentine is followed by aloes, or aloes is given prior to a course of iron sulphate and gentian, for the destruction of round-worms in horses. A laxative ball may be composed of aloes (3 ii.-iv.), ginger and powdered nux vomica (each 3 ii.), mixed with glycerin or molasses.

It is often taught that aloes is contraindicated in hemorrhoids, but this teaching does not obtain unless the piles are inflamed. In piles, associated with an atonic condition, aloes may be beneficial by improving the tone of the bowels. The U. S. P. compound laxative pills is one of the best laxatives in chronic constipation of dogs and cats. Each pill contains $\frac{1}{120}$ gr. of strychnine. Aloes may be useful in jaundice due to constipation, but in general it is inferior to

salines, calomel and podophyllin in the treatment of this disorder. According to Brunton, the presence of bile in the intestines is essential for the action of aloes. Therefore the absence of bile in the bowels would forbid the use of aloes as a purgative. Laxative doses of aloes are valuable in amenorrhea, or absence of estrum, about the time that "heat" should occur, in combination with iron.

Oleum Lini. Linseed Oil. (U. S. & B. P.)

Synonym.—Oil of flaxseed, E.; huile de lin, Fr.; leinöl, leinsamenöl, G.

A fixed oil expressed from linseed without the use of heat.

Properties.—A yellowish or yellow, oily liquid, having a slight, peculiar odor and bland taste. When exposed to the air it gradually thickens and acquires a strong odor and taste; and if spread in a thin layer on a glass plate and allowed to stand in a warm place, it is gradually converted into a hard, transparent, resin-like mass (absence of non-drying oils).

Spec. gr. 0.925 to 0.935 at 77° F. Soluble in about 10 parts of absolute alcohol, and in all proportions in ether, chloroform, benzin, carbon disulphide, or oil of turpentine.

Constituents.—1, linolein; 2, myristin; 3, palmitin; 4, albumin, which gives the oil its drying qualities.

Dose.—H., Oss.-i. (250.-500.). Mild laxative, on bran mash. C., Oi.-ii. (500.-1000.); Sh. & Sw., ℥ vi.-xii. (180.-360.); D. & C., ℥ ss.-ii. (15.-60.)

Action and Uses.—Linseed oil exerts a laxative, or mild purgative effect by its mechanical action in lubricating the bowels and their contents. It is suitable for horses when a derivative or depleting action is not desirable, as in fecal impaction or overloaded bowels in weak animals, and in those suffering from inflammatory diseases of the respiratory tract or digestive organs; diarrhea, dysentery, and in pregnancy. Aloes, on the other hand, would be contraindicated in these conditions. Carron oil (linseed oil and lime water, equal parts), is particularly appropriate as a remedy for "heaves" in horses (℥ ii.-iv.), and is one of the best cathartics for foals, lambs and calves (℥ ii.-iv.). The laxative and antacid properties of this preparation tend to combat intestinal fermentation which is so common in young animals with digestive disorders and diarrhea. The same qualities of carron oil prevent flatulence and interference with the already impeded breathing in "heaves" of horses.

Linseed oil is frequently given to ruminants, although Epsom salts is generally the best purge for them. It is indicated for these

animals when a milder operation than that obtained by a full dose of salts is required, and for its demulcent action in irritable states of the digestive organs. Linseed oil, combined with salts, is useful in impaction of the rumen and omasum in cattle. By combining linseed oil with croton oil we procure a potent purge for cattle. Castor oil or sweet oil are usually preferable to linseed oil in the treatment of dogs. Soap suds enemata are made more effective by the addition of 1 or 2 pints of linseed oil (for horses), and 1 or 2 ounces (for dogs). The oil may be given in its pure state, but more uncommonly is prescribed with gruel, glycerin, mucilage, or molasses. One ounce each of linseed oil and molasses may be given to the larger animals; or one drachm of either to the smaller animals, as an expectorant in bronchitis. The mixture is often a most serviceable one and probably acts by improving the nutrition of the bronchial mucous membrane. Linseed oil and sweet oil resemble cod liver oil in this respect, and while both are probably inferior to the latter, as expectorants, they are more palatable and cheaper.

Oleum Ricini. Castor Oil. (U. S. & B. P.)

Synonym.—Oleum palmæ christi, huile de ricin, Fr.; ricinusöl, G.

A fixed oil expressed from the seed of Ricinus communis Linné (nat. ord. Euphorbiaceæ).

Habitat.—India. Cultivated in many countries.

Properties.—A pale, yellowish and almost odorless, transparent, viscid fluid, having a bland, afterwards slightly acrid, and generally offensive taste. Spec. gr. 0.945 to 0.965 at 77° F. Soluble in equal volumes of alcohol, and in all proportions in absolute alcohol, or in glacial acetic acid; also soluble in three times its volume of 92.5 per cent. alcohol (absence of more than about 5 per cent. of most other fixed oils).

Constituents.—1, ricinolein, or ricinoleic acid glyceride, $C_3H_5(C_{18}H_{34}O_3)_3$; 2, an acrid principle; 3, palmitin, stearin and myristin; 4, possibly a non-purgative alkaloid, ricinine.

Dose.—H. & C., Oi. (500.); Sh. & Sw., ℥ ii.-iv. (60.-120.); D. & Cats, ℥ i.-ii. (30.-60.); poultry, ℥ i. (4.).

Castor Oil Seeds.—These are not official. The name Ricinus is applied to the plant because of the resemblance of the seed to a ricinus, or tick. The seeds are of a shiny, gray color, marked with brownish spots and streaks. They are about the size of small beans (17 Mm. × 8 Mm.), ovoid, flattened, and white inside. They contain 50 per cent. of oil, and an acrid, poisonous substance, a toxalbu-

min, ricin. Three seeds have caused death in man, and they are ten times more purgative than the oil.

Action and Uses.—Castor oil closely resembles olive oil save that when saponified ricinoleic, instead of oleic, acid is formed. In the intestines the ricinoleic acid is further changed to ricinoleates which are irritant and therefore cause purgation. Much of the castor oil is absorbed like other oils and in China castor oil is even used for food. Castor oil is mild, but has a more decided purgative action than linseed oil and often occasions griping. It acts within 4 or 5 hours and will purge when absorbed from the skin or rectum. Castor oil is specially applicable in canine practice, to unload the bowels, and in irritated conditions of the digestive tract. It is useful in constipation only as an occasional remedy, since it is followed by greater tendency to this condition. It is generally used as an occasional remedy in constipation but small doses are sometimes given daily in chronic constipation. It is also indicated in overloaded bowels, indigestion, diarrhea, and pregnancy; after the ingestion of foreign or putrid matters; and to assist the action of anthelmintics. Castor oil is inferior to linseed oil for horses, as a simple laxative, because it is more prone to cause colicky pains, and because it is more expensive. Castor oil is thought to be notably useful in irritation and inflammation of the intestines in these animals, however, as in diarrhea, dysentery, and enteritis; and can be combined with anodynes and antispasmodics to prevent griping. Two or three ounces of castor oil are suitable for calves or foals with gastro-intestinal disorders. One or two teaspoonfuls are suitable for poultry.

Administration.—Castor oil is given to dogs with syrupus rhamni cathartici in the proportion of 1 ounce of the former to 1 drachm of the latter; or with glycerin (equal parts) and a few drops of oil of wintergreen. It is administered to puppies (℥ i.-ii.) with an equal volume of sweet oil. Castor oil may be exhibited to horses with oil of peppermint (♏xx.); or in digestive irritation, in warm cooked flour gruel with laudanum (℥ ss.) and fluidextract belladonna (℥ i.); to foals and calves with mucilage or gruel and 5 drops of oil of peppermint.

Rhamnus Purshiana. (U. S. P.) Cascara Sagrada. (B. P.)

Synonym.—California buckthorn, sacred bark, chittem bark.

The bark of Rhamnus Purshiana de Candolle (nat. ord. Rhamnaceæ). Collected at least one year before being used.

Habitat.—United States from northern Idaho west to Pacific Ocean.

Description.—In quills or curved pieces, of variable length and

1 to 5 Mm. thick; outer surface reddish-brown, frequently more or less covered with grayish or whitish lichens, several of which are peculiar to this bark, and with small groups of their brownish fruit-heads; inner surface yellowish to light brownish, becoming dark brown with age and reddened by alkalies, longitudinally striate; fracture short, with projections of bast fibres in the inner bark, and the medullary rays forming converging groups; odor distinct; taste bitter and slightly acrid.

Constituents.—1, three resins; 2, a neutral body; 3, a volatile oil; 4, malic and tannic acids.

Dose.—D., gr. v.-xxx. (.3-2.).

PREPARATIONS.

Fluidextractum Rhamni Purshianæ. Fluidextract of Rhamnus Purshiana.

Made by maceration and percolation with diluted alcohol, and evaporation, so that 1 cc. = 1 gm. of the crude drug. (U. S. P.)

Dose.—D., ♏v.-xxx. (.3-2.).

Fluidextractum Rhamni Purshianæ Aromaticum. (U. S. P.)

Dose.—♏v.-xxx.

Extractum Cascaræ Sagrade Liquidum. (B. P.)

Dose.—D., ♏v.-xxx. (.3-2.).

Extractum Cascaræ Sagradæ. (B. P.)

Dose.—D., gr.ii.-viii. (.12-.5).

Syrupus Cascaræ Sagradæ Aromaticus. (B. P.)

Dose.—D., ʒss.-ii. (2.-8.).

Frangula. Frangula. (U. S. P.)

Synonym.—Rhamni frangulæ cortex, B. P.; buckthorn, alder buckthorn, black alder, E.; bourdaine, bourgène, Fr.; faulbaumrinde, G.; cortex frangulæ, P. G.

The dried bark of Rhamnus Frangula Linné (nat. ord. Rhamneæ), collected at least one year before being used.

Habitat.—Europe and northern Asia.

Description.—In quills of variable length, frequently flattened or crushed; bark 0.3 to 1 Mm. thick, externally grayish-brown to purplish-black, with numerous lenticels and occasional patches of foliaceous lichens; inner surface smooth, minutely striated, brownish-yellow to deep brown; fracture short and of a purplish tint in the outer layer, fibrous and pale yellow in the inner layer; odor

distinct; taste somewhat aromatic, sweetish, and bitter; when chewed, imparting to the saliva a yellow color.

Constituents.—1, a glucoside, frangulin ($C_{20}H_{20}O_{10}$), converted in time into (2) emodin ($C_{15}H_{10}O_5$), a glucoside, to which the drug owes its purgative action. Frangulin also yields emodin, a constituent of rhubarb as well, and rhamnose ($C_6H_{12}O_5$), by hydrolysis.

Dose.—D., 3 ss.-i. (2.-4.).

PREPARATIONS.

Fluidextractum Frangulæ. Fluid extract of Frangula. (U. S. P.)

Made by maceration and percolation with alcohol and water, and evaporation, so that 1cc. of the preparation = 1 gm. of the crude drug.

Dose.—D., 3 ss.-i. (2.-4.).

Actions and Uses.—The buckthorns are laxatives in the doses employed in medicine. The fresh bark of R. frangula produces violent gastroenteritis (frangulin), and the same effect is produced by the bark of cascara sagrada, so that both should be kept a year before using.

Frangula is rarely employed, but Cascara sagrada is one of the best purgatives for chronic constipation in dogs. The dose does not require to be increased on repetition. On the contrary, the tone of the bowels is improved by the drug. It has a very bitter taste and is apt to cause griping so that cascara is commonly given with aromatics. Fluidextractum Rhamni Purshianæ Aromaticum (U. S. P.), Syrupus Cascaræ Sagradæ Aromaticus, are the best preparations. A solid and fluidextract are also official (U. S. & B. P.). The aromatic syrup of cascara sagrada may be prescribed to advantage with an ounce or two of castor oil, as an occasional purgative for dogs. A syrup of purging buckthorn (Rhamnus catharticus) is also occasionally given dogs and cats with castor oil. D., ℥ i.-ii.; Cats, ℥ ss.-i.

Phenolphthalien, $C_{20}H_{14}O_4$.

Is made from phenol, phthalic anhydride and sulphuric acid by the action of heat. It occurs in white, yellowish or grayish-white amorphous or crystalline powder. It is tasteless and odorless, and soluble in 600 parts of water, in 10 parts of alcohol, and in solutions of hydroxides and carbonates. Its solutions in acids are colorless but with alkalies turn red. It is used in chemistry as an indicator of acidity or alkalinity. It does not apparently have any other physiological effect than that of a purgative and is especially indi-

cated in habitual constipation. It does not cause griping, and produces no bad effect on the system even when used over long periods of time. It is sometimes prescribed with aloes. Phenolphthalein is eliminated chiefly by the intestines.

Dose.—H., ʒ i.-ʒ iss. (4.-6.); dogs, gr. ii.-x. (0.12-0.6); puppies and cats, gr. ss.-ii. (0.03-0.12).

Phenolphthalein may be given to horses with food. To dogs and cats it is given in capsule, or tablets with chocolate (Thaletts, Mulford), or in pill with aloes, strychnine, belladonna and cascara (Phenalos, Mulford).

Rheum. Rhubarb. (U. S. P.)

Synonym.—Rhei radix, B. P.; rhubarbe, Fr.; rhubarber, G.

The dried rhizome of *Rheum officinale* Baillon, *Rheum palmatum* Linné, and the var. *tanguticum* Maximowicz (Fam. *Polygonaceæ*), or probably other species of *Rheum*, grown in China and Thibet, and deprived of most of the bark and carefully dried.

Description.—Subcylindrical, barrel-shaped, conical, plano-convex or irregularly formed pieces, frequently with a large perforation; hard and moderately heavy; 5 to 15 Cm. long, 4 to 8 Cm. in diameter; externally mottled with alternating striæ of light brown parenchyma cells and dark brown medullary rays, occasionally with reddish-brown cork patches and small, radiate scars of fibrovascular tissue, smooth and sometimes covered with a bright brownish-yellow powder; fracture somewhat granular, presenting a peculiar marbled appearance; odor characteristic; taste bitter, astringent; gritty when chewed.

Powder bright orange-yellow, becoming red with alkalies, containing rosette-shaped crystals of calcium oxalate which are from 0.050 to 0.100 Mm. in diameter, and spherical starch grains from 0.005 to 0.020 Mm. in diameter, either single or 2- to 4- compound.

Constituents.—1, the purgative principle which gives the yellow color, a glucoside, chrysarobin ($C_{27}H_{30}O_{14}$), yields 2-3 per cent. of chrysophanic acid ($C_{15}H_{10}O_4$), also called rhein or chrysophan; 2, rheotannic acid ($C_{26}H_{26}O_4$), which gives astringency to rhubarb; 3, calcium oxalate (35 per cent.), causing grittiness; 4, resinous bodies: phæoretin, emodin, aporetin and erythroretin. Chrysophanic acid and the resins are somewhat purgative, but the exact purgative principles have yet to be discovered.

Dose.—Stomachic—H. & C., ʒ i.-ii. (30.-60.); Sh., ʒ i. (4); D. & Cats, gr. v.-x. (.3-.6).

Mild Purgative.—Foals and calves, ʒ i.-ii. (4.-8.); D., ʒ i.-ii. (4.-8.). Fowl, gr. v.-vii. in pill.

PREPARATIONS.

Fluidextractum Rhei. Fluidextract of Rhubarb. (U. S. P.)

Made by maceration and percolation with alcohol and water, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—Same as that of rhubarb.

Pulvis Rhei Compositus. Compound Powder of Rhubarb. (U. S. & B. P.)

Synonym.—Gregory's powder. Rhubarb, 25; magnesia, 65; ginger, 10.

Dose.—Foals and Calves, ʒ ss.-i. (15.-30.).

Extractum Rhei. Extract of Rhubarb. (U. S. & B. P.)

Dose.—D., gr.v.-x. (.3-.6).

There are many other official preparations, but they possess no value in veterinary medicine.

Action Internal.—Alimentary Canal.—Rhubarb is a bitter, and therefore in small doses improves digestion in all animals by increasing the flow of salivary and gastric juices, and by stimulating the appetite, vascularity, and movements of the stomach. It is called a stomachic and bitter tonic. Larger doses cause mild purgation in the case of dogs and cats, but horses and cattle are but slightly affected in this way. The activity of rhubarb is partly due to the solvent action of bile. It is commonly described as an agent which stimulates peristaltic action, but it is not certainly known how purging is brought about. Secondary constipation is more apt to follow the use of rhubarb than other drugs, because of rheotannic acid. This substance may be absorbed and eliminated into the bowels after the occurrence of purgation. Rhubarb, by virtue of chrysophanic acid, stains the feces, urine, milk and sweat yellow in its excretion.

Uses.—Rhubarb is an efficient laxative remedy for the treatment of indigestion in young animals associated with diarrhea. In this condition it sweeps out the source of irritation and then exerts an astringent effect. The drug often acts most favorably with an antacid in the disorders noted. Gregory's powder is useful in the care of foals, calves and lambs with diarrhea. The fluidextract may be given to dogs, but rhubarb is not so generally useful a purgative for these animals as castor oil, calomel, cascara sagrada, phenolphthalein, or compound laxative pills. Rhubarb has been recommended when a laxative is desirable, in cases of hemorrhoids, to improve local tone, and also as a purgative in diarrhea of young animals due to worms.

One or two drops of the tincture of rhubarb in the drinking water form a serviceable laxative for small birds.

Chrysarobinum. Chrysarobin. (U. S. & B. P.)

Synonym.—Goa powder, araroba powder.

A neutral principle, extracted from Goa Powder, a substance found deposited in the wood of Vouacapoua Araroba (Aguiar) Druce (nat. ord. Leguminosæ).

Habitat.—Brazil.

Properties.—A pale orange-yellow, microcrystalline powder, odorless and tasteless; turning brownish-yellow on exposure to the air. Very slightly soluble in cold water or alcohol. Soluble in solutions of alkalies.

Constituents.—Chiefly chrysarobin ($C_{27}H_{30}O_{14}$)—also called rhein and chrysophan,—an orange-yellow, crystalline glucoside, somewhat soluble in alcohol and ether; freely soluble in chloroform and benzol. It is oxidized into chrysophanic acid ($C_{15}H_{10}O_4$), and glucose.

PREPARATION.

Unguentum Chrysarobini. Chrysarobin Ointment. (U. S. & B. P.)

Chrysarobin, 6; benzoinated lard, 95. (U. S.)

Action and Uses.—Chrysarobin is a powerful irritant to the skin and destroys parasites. It stains the skin and other materials dark brown. This may be removed, unless fixed by an alkali, with a weak solution of chlorinated lime or caustic soda. Chrysarobin is also a strong irritant in the gastro-intestinal tract, causing vomiting and purging in carnivora. It is eliminated by the kidneys, coloring the urine yellow.

Chrysarobin is used as a parasiticide in the treatment of ringworm, and as a stimulant to the skin in chronic cutaneous disorders, as eczema (with much itching and scaling), and in alopecia areata. The official 5 per cent. ointment should be diluted 2 or 3 times for delicate skins. It should be applied over a large area with care, but is one of the most efficient remedies in obstinate diseases of the skin.

Senna. Senna.

Synonym.—Senna Alexandrina, senna Indica, B. P.; senna leaves, folia sennæ, E.; feuilles de séné, Fr.; sennesblätter, G.

The dried leaflets of Cassia acutifolia Delile (Alexandria Sen-

na), and of Cassia augustifolia Vahl (India Senna); nat. ord. Leguminosæ).

Description.—Alexandria Senna.—Leaflets about 25 m. long and 10 Mm. broad, having extremely short, stout petioles; inequilaterally lanceolate or lance-ovate, acutely cuspidate, entire, subcoriaceous, brittle, pale green or grayish-green, sparsely and obscurely hairy, especially beneath, the hairs appressed, 1-celled, and thick-walled; odor characteristic; taste somewhat mucilaginous and bitterish.

India Senna.—Leaflets 25 to 50 Mm. long, 10 to 15 Mm. broad, inequilaterally lanceolate, entire, thin, more abruptly pointed than those of Alexandria Senna, yellowish-green, and smooth above, paler beneath; in odor and taste closely resembling Alexandria Senna.

Senna should be free from stalks, and from Argel leaves, which are sometimes present in Alexandria Senna, and which are equilateral, 1-veined, thick, wrinkled, glaucous, and possess 3-celled hairs.

Habitat.—Alexandria Senna.—Upper Egypt, Nubia, and Central Africa.

Indian Senna, or *Tinnivelly Senna.*—Eastern Africa to India.

Constituents.—1, the purgative properties are chiefly due to magnesium and calcium cathartates; salts of cathartic acid ($C_{180}H_{192}N_{82}SO_2$), a black, amorphous sulphurated glucoside; 2, two glucosides, sennacrol and sennapicrin, insoluble in water; 3, chrysophanic acid; 4, cathartomannit ($C_{21}H_{44}O_{19}$), an unfermentable sugar.

Dose.—H. & C., ʒ iv.-v. (120.-150.); Sh. & Sw., ʒ i.-ii. (30.-60.); D. & C., ʒ i.-iv. (4.-15.); fowl, gr. xv.-xx. in pills.

PREPARATIONS.

Fluidextractum Sennæ. Fluidextract of Senna. (U. S. P.)

Made by maceration and percolation with diluted alcohol, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—Same as senna.

Pulvis Glycyrrhizæ Compositus. Compound Powder of Glycyrrhiza. (U. S. & B. P.)

Synonym.—Compound liquorice powder.

Senna, 180; glycyrrhiza, 236; washed sulphur, 80; oil of fennel, 4; sugar, 500.

Dose.—D., ʒ ss.-ii. (2.-8.).

Syrupus Sennæ. (U. S. & B. P.)

Dose.—D., ʒ i.-iv. (4.-15.).

Action Internal.—Senna stimulates and increases the vascularity of the intestinal mucous membrane, and causes increased peristalsis

of the large intestines, particularly of the colon. It produces copious pale-yellow and watery evacuations. The drug has a nauseous taste and purging is accompanied by some griping and flatulence. Senna acts more satisfactorily when combined with other purgative agents. It is absorbed and will occasion catharsis in sucklings after administration to their mothers, and after intravenous injection. The urine may be colored red or yellow by its elimination. It is extremely doubtful if senna exerts any influence on biliary secretion.

Uses.—Senna is but rarely employed in veterinary medicine. It may be used where a simple, vigorous cathartic is indicated in constipation, or in cases of slight fecal accumulation.

The drug acts more effectively when given in conjunction with salts. The fluidextract, or an infusion made by pouring boiling water over the leaves and allowing them to macerate until the water becomes cold, are added to solutions of magnesium sulphate. This combination is more suitable for cattle or sheep. The syrup or compound liquorice powder may be given to dogs as simple purgatives in occasional or habitual constipation.

Class 2.—Drastic Purgatives.

Oleum Tiglii. Croton Oil. (U. S. P.)

Synonym.—Oleum crotonis, B. P.; huile de croton, huile de graines de tilly, Fr.; crotonöl, G.

A fixed oil expressed from the seed of Croton Tiglium Linné (nat. ord. Euphorbiaceæ).

Habitat.—India, Indian Archipelago, and Philippine Islands. Also cultivated.

Properties.—A pale yellow or brownish-yellow, somewhat viscid, and somewhat fluorescent liquid, having a slight fatty odor, and a mild, oily, afterwards burning and acrid taste (great caution is necessary in tasting). Spec. gr. 0.935 to 0.950 at 77° F. When fresh it is soluble in about 60 parts of alcohol, the solubility increasing by age. It is freely soluble in ether, chloroform, carbon disulphide, and in fixed and volatile oils.

Constituents.—1, crotonoleic acid, the purgative principle. A slight amount is free in the oil but it is mostly formed in the bowels. It resembles ricinoleic acid in its chemistry; 2, crotonol ($C_{18}H_{24}O_4$), a non-purgative body causing irritation of the skin; 3, tiglinic acid ($C_5H_8O_2$), and many volatile acids existing as glycerides and accounting for the odor of croton oil; 4, free and combined fatty acids.

Dose.—H., ♏xv.-xxx.(1.-2.); C., 3 ss.-i. (2.-4.); Sh. & Sw., ♏v.-x. (.3-.6); D., ♏ss.-iii. (.03-.18).

Croton seeds resemble castor seeds in size, but are not mottled or shiny. They are 13 Mm. long by 8 Mm. wide; oval in shape; white within, and possessing a mild, mucilaginous taste at first, but soon becoming hot and sharp. They contain from 50 to 60 per cent. of croton oil and a toxalbumin, crotin, which is, however, less poisonous than the toxalbumin of castor oil seeds, Ricin.

Action External.—Croton oil is a most powerful irritant, causing pain, redness and swelling of the skin, soon followed by vesicles and pustules. Permanent destruction of the hair follicles succeeds with loss of hair and cicatrices. When applied to the skin, injected into the blood or under the skin, it is eliminated to some extent by the bowels, producing purging; and sometimes by the kidneys, creating diuresis, irritation of these organs and strangury.

Action Internal.—The acrid, irritant, purgative principle of croton oil is crotonoleic acid. Some already exists free in the oil while more is formed by saponification or decomposition of the oil in the bile and alkaline juices of the bowels into crotonoleic acid and glycerin. Croton oil is an intense internal irritant. It increases the vascularity of the stomach and bowels and in large doses creates gastro-enteritis. Medicinal doses notably augment the intestinal secretions—but not that of bile—and to a degree peristalsis. The drug may act in half an hour, but usually within a few hours, and purgation is attended with colicky pain and griping. The movements are very fluid and sometimes contain blood. Croton oil is therefore a drastic hydragogue cathartic. The purgative action is probably due in part to direct irritation of the intestinal mucous membrane; in part to absorption and elimination of the purgative principle by the bowels.

Toxicology.—Ten drops of croton oil will kill a dog unless vomiting occurs. Eight to thirty drops prove fatal to a horse, intravenously. The treatment of poisoning includes the use of emetics or stomach tube, demulcents and opium.

Administration.—Croton oil may be placed on the tongue of an unconscious animal, in a small quantity of linseed oil, olive oil, or lard. The oil can also be given in enema with a pint of linseed oil. It may be exhibited to dogs in pill, castor oil, or rubbed up with a little butter and smeared on the back of the tongue. Croton oil (in a pint of linseed oil) is valuable in assisting the action of salts in obstinate constipation of cattle. It may be administered to horses (♏x.), when a powerful derivative and purgative action is indicated, as in acute inflammation of the brain and cord, with calomel and aloes in ball.

Uses External.—Croton oil is ordinarily superseded by milder counter-irritants, as turpentine, mustard, or stimulating liniments; but it may be employed so as to secure any degree of irritation according to its strength. It is occasionally used for horses in acute diseases of the brain, applied around the poll and on the back of the neck; 1 part (20-30 ♏), with 30 parts each of oil of turpentine and linseed oil; in acute disorders of the chest (10-15 ♏ on either side) and abdomen (40 ♏), similarly diluted.

Absorption, purging and revulsant action may be secured by the external application of croton oil. Croton oil is more often employed in cattle (1-6 or 10, with cod liver oil) for its counter-irritant effect when rubbed into the skin, as in laryngitis, glandular enlargement, and rheumatic joints. It is less likely to cause severe inflammation and blemishing than in horses. For swine, croton oil is diluted with 2 volumes of linseed or cod liver oil.

Uses Internal.—Croton oil is more suitable as a drastic cathartic for cattle, than for horses. It is prescribed in obstinate constipation (not of organic origin) when other remedies fail. Also in unconscious conditions where its small bulk will allow of its exhibition. Again, for its derivative and rapid effect in cerebral congestion, parturient apoplexy, etc. Croton oil may be given to dogs and pigs in similar conditions. The oil is too irritant for horses to justify its use save in exceptional cases.

Scammonium. Scammony. (U. S. & B. P.)

Synonym.—Scammonée, Fr.; scammonium, G.

A gum resin obtained by excising the living root of Convolvulus Scammonia Linné (nat. ord. Convolvulaceæ).

Habitat.—Syria.

Description.—In circular cakes or irregular, angular pieces of various sizes, greenish-gray or brownish-black, often covered with a grayish-white powder; very brittle, breaking with an angular fracture, porous and of a resinous lustre; internally of a uniform brownish-black color, more or less translucent in thin fragments; odor peculiar, somewhat cheese-like; taste slightly acrid.

Scammony is easily reduced to an ash-gray powder, which when triturated with water yields a greenish emulsion; ether dissolves at least 75 per cent. of it.

Constituents.—1, a resin (80-95 per cent.); 2, gum; 3, starch.

Dose.—D., ʒ i.-ii. (4.-8.); Cats, ʒ ss.-i. (2.-4.); Sw., ʒ ii.-iv. (8.-15.).

PREPARATION.

Resina Scammonii. Resin of Scammony. (U. S. P.)

Scammoniæ Resina. (B. P.)

Derivation.—Made by solution in boiling alcohol, and precipitation with water.

Properties.—Yellowish-brown or brownish-yellow masses or fragments, breaking with a glossy, resinous fracture; translucent at the edges; or a yellowish-white or grayish-white powder, having a faint, peculiar odor, and a slight, peculiar taste. Soluble in alcohol, ether, and oil of turpentine.

Constituents.—Mainly scammonin ($C_{88}H_{156}O_{42}$), identical with jalapin.

Dose.—One-half that of scammony.

Jalapa. Jalap. (U. S. & B. P.)

Synonym.—Tuber jalapæ, P. G.; jalap, radix jalapæ, Fr.; jalape, jalapenknollen, G.

The dried tuberous root of *Exogonium Purga* (Wenderoth) Bentham (Fam. *Convolvulaceæ*), yielding not less than 8 per cent. of total resin, but not more than 1.5 per cent. of resin soluble in ether.

Habitat.—Mexico.

Description.—Napiform, pyriform or oblong, 3 to 8 Cm. long and 1 to 5 Cm. in diameter, the large roots often incised, more or less wrinkled, dark brown, with lighter colored spots, and short transverse ridges; hard, compact, internally dark brown, with numerous concentric circles composed of small resin cells; fracture resinous, lustrous, not fibrous; odor slight, but peculiar, smoky and sweetish; taste sweetish and acrid.

Constituents.—1, a hard resin, chiefly the glucoside jalapurgin; 2, a soft resin.

Dose.—D., 3 i.-ii. (4.-8.); Cats, 3 ss.-i. (2.-4.); Sw., 3 ii.-iv. (8.-15.)

PREPARATIONS.

Pulvis Jalapæ Compositus. (U. S. & B. P.)

Jalap, 35; potassium bitartrate, 65. *Dose*—D., gr.xv.-lx.

Resina Jalapæ. Resin of Jalap. (U. S. & B. P.)

Derivation.—Made by maceration and percolation with alcohol, partial distillation; precipitation with water; washing and drying.

Properties.—Yellowish-brown or brown masses or fragments, breaking with a resinous, glossy fracture, translucent at the edges, or a yellowish-gray or yellowish-brown powder, having a slight, peculiar odor, and a somewhat acrid taste. Permanent in the air. Soluble in alcohol; insoluble in carbon disulphide,

benzol, and fixed and volatile oils. Not more than 10 per cent. of it is soluble in ether.

Constituents.—1, jalapurgin or convolvulin ($C_{62}H_{100}O_{32}$), the most active principle; insoluble in ether; 2, jalapin, identical with scammonin; 3, starch or gum.

Dose.—One-quarter that of jalap.

ACTION OF SCAMMONY AND JALAP.

Scammony and jalap are powerful hydragogue cathartics in their action on swine, dogs and cats. Horses and cattle are but slightly affected by them in ordinary doses. Their resins are dissolved by the bile in the duodenum, and a purgative substance is formed which chiefly stimulates the intestinal glands and causes a copious outpouring of secretion.

Both drugs excite peristaltic action and increase the vascularity of the intestinal mucous membrane, particularly scammony, so that griping may occur. They produce gastrointestinal irritation, with vomiting and purging, in animals capable of the act, after large doses. While jalap and scammony are active purgatives, they are not always certain, and are therefore more frequently employed in combination with other cathartics. They are indirectly cholagogue—like calomel—in sweeping out bile from the small intestines and preventing its reabsorption, and are said to be anthelmintics as well. The active principles of both drugs are absorbed, as death has taken place in an infant after exhibition of scammony to its nurse, and purging has followed the rubbing of jalap into the shaven skin of dogs.

Uses.—Jalap is in more common use than scammony because it is somewhat more of a hydragogue and less prone to cause griping. It is particularly indicated in dropsy or ascites of dogs, made into pills with 3 grains of calomel. Jalap may also be given to expel round or thread worms; in torpidity of the liver; and in obstinate constipation in dogs. The latter is treated more satisfactorily by massage, rectal enemata, manual evacuation and repeated doses of sweet oil.

Cambogia. Gamboge. (U. S. & B. P.)

Synonym.—Gutti, P. G.; gummi resina guttæ s. gutti, gutta gamba, cambodia, gutte, gomme-gutti, Fr.; gummigutt, gutti, G.

A gum-resin obtained from Garcinia Hanburii Hooker filius (nat. ord. Guttiferæ).

Habitat.—Siam, Anam, and Camboja.

Properties.—In cylindrical pieces, usually hollow in the centre,

of variable length, 2 to 5 Cm. in diameter, externally grayish orange-brown, longitudinally striate; fracture conchoidal, orange-red, waxy, and somewhat porous; inodorous; taste very acrid.

Powder bright yellow, sternutatory, containing few or no starch grains. Not more than 25 per cent. should be insoluble in alcohol; ash not more than 3 per cent.

Constituents.—1, gambogic acid, a bright yellow or orange-red resin, to the extent of about 75 per cent. of the crude drug; it is not so active as the crude drug; 2, a soluble gum.

Dose.—H., ʒ ss.-i. (15.-30.); C., ʒ i.-iss. (30.-45.); Sh. & Sw., gr. xx.-ʒ i. (1.3-4.); D., gr. v.-x. (.3-.6).

Action and Uses.—Gamboge is a drastic, hydragogue purgative, and slightly diuretic. Its action is uncertain and often violent, with production of griping pains. Large doses cause vomiting in carnivora and omnivora, and gastro-enteritis in all animals.

Gamboge is dissolved by the bile and alkaline intestinal juices and some of it is absorbed, since it colors the urine yellow in its elimination and occasions diuresis. Attempts to create catharsis by injection of gamboge into the blood, have proved futile. Gamboge should never be prescribed alone and is rarely used in veterinary medicine. It has been recommended in obstinate constipation, indigestion, impaction of the third stomach, and cerebral diseases of cattle, combined with salts, or rubbed up with water and an equal amount of aloes (aaʒi). The gum forms an emulsion when the drug is triturated with water.

Colocynthis. Colocynth. (U. S. P.)

Synonym.—Colocynthidis pulpa, B. P.; coloquintida, bitter apple, E.; coloquinte, Fr.; koloquinten, G.

The peeled and dried fruit of Citrullus colocynthis Schrader (nat. ord. Cucurbitaceæ).

Habitat.—A vine growing in North and South Africa, South and West Asia, and Japan, etc.

Description.—From 5 to 10 Cm. in diameter; globular, white or yellowish-white; light, spongy, readily breaking into three wedge-shaped pieces, each containing, near the rounded surface, many flat, ovate, brown seeds; inodorous; taste intensely bitter. The pulp only should be used; the seeds separated and rejected.

Constituents.—1, the chief purgative principle is colocynthin ($C_{56}H_{84}O_{23}$), 1-2 per cent. An amorphous or crystalline bitter glucoside. Soluble in water and alcohol. There is also (2) an insoluble, resinous body called colocynthitin, colocynthein or citrullin.

Dose.—Colocynthin.—H., 3 ss.-i. (2.-4.); D., gr. ¼-i. (.015-.06).

Colocynth.—D., gr. ii.-iii. (.12-.18).

ELATERINUM. Elaterin. $C_{20}H_{28}O_5$. (U. S. & B. P.)

Synonym.—Cucumis asininus, cucumis agrestis, wild or squirting cucumber, E.; concombre sauvage (purgatif d'ane), Fr.; springgurke essels-kürbis, spritzgurke, G.

A neutral principle obtained from elaterium, a substance deposited by the juice of the fruit of Ecballium Elaterium (Linné) A. Richard (nat. ord. Cucurbitaceæ).

Habitat.—Elaterium grows in North Africa, West Asia and Southern Europe. It is also cultivated.

Derivation.—Elaterium is exhausted with chloroform. Ether is added and elaterin is precipitated and is purified by redissolving in chloroform and crystallizing.

Properties.—Minute, white, hexagonal scales, or prismatic crystals, without odor, and having a slight, acrid, bitter taste. Insoluble in water, and in 262 parts of alcohol; also soluble in 318 parts of ether, or in 22 parts of chloroform. Permanent in the air.

Dose.—D., gr. $\frac{1}{20}$-$\frac{1}{12}$ (.003-.005).

ACTIONS AND USES OF COLOCYNTH AND ELATERIN.

The action of colocynth and elaterin is similar in man, but the latter is more powerful. Both greatly increase secretions while they stimulate peristalsis in some degree. Large doses cause painful griping, gastro-intestinal inflammation, excessive watery purging, and collapse. Elaterin frequently fails to purge horses and dogs, although death may follow large doses. Colocynth acts more certainly in the lower animals and is recommended by P. Cagny in dropsy and cerebral disease. Neither drug, however, is of any importance in veterinary medicine. Colocynth is contained in the compound cathartic pill given to dogs in doses of from one to three pills.

PODOPHYLLUM. Podophyllum.

Synonym.—Podophylli rhizoma, B. P.; May apple, mandrake root, E., podophylle, Fr.; fussblatwurzel, G.

The dried rhizome of Podophyllum pellatum Linné (nat. ord. Berberideæ).

Habitat.—North America.

Description.—Of horizontal growth and variable length, subcylindrical, flattened above, sometimes branched, consisting of joints 5 to 10 Cm. long, the internodes 2 to 8 Mm. thick; externally pale yellowish-brown to dark brown, nearly smooth; nodes annulate, the upper surface being marked by large cup-shaped scars, the lower surface with numerous root-scars or remains of roots; fracture short, the fractured surface mealy or horny, whitish to pale brown, with a circle of small wood-bundles, and a large pith; odor slight, more pronounced and characteristic in the powder; taste sweetish and disagreeably bitter and acrid.

Constituents.—1, a resin, podophyllin (4-5 per cent.); 2, a coloring matter, podophyllic acid.

PREPARATION.

Resina Podophylli. Resin of Podophyllum. (U. S. & B. P.)

Synonym.—Podophyllin.

Derivation.—Made by maceration and percolation of podophyllum with alcohol; partial evaporation, and precipitation of the resin with diluted hydrochloric acid; washing with water, drying.

Properties.—An amorphous powder, varying in color from grayish-white to pale greenish-yellow or yellowish-green; having a slight, peculiar odor, and a peculiar, faintly bitter taste. Permanent in the air. Soluble in alcohol and in solutions of potassium and sodium hydrate.

Constituents.—Chiefly podophyllotoxin ($C_{23}H_{24}O_9 + 2\ H_2O$), stated to be a mixture of a purgative principle, picropodophyllin, and an inert body, podophyllinic acid, associated with a coloring matter, podophylloquercitin, and other resins.

Dose.—H. & C., ℥ i.-ii. (4.-8.); D., gr.i.-ii. (.06-.12).

Pilulæ Podophylli, Belladonnæ et Capsici. Pills of Podophyllin, Belladonna and Capsicum. (U. S. P.)

Dose.—D., 1 pill.

Action.—Podophyllin is a powerful though slow acting cathartic. Podophyllotoxin when given in large doses under the skin or into a vein causes glomerular nephritis and hemorrhages into various organs. Large doses cause purging and vomiting in animals, and lethal quantities occasion gastro-enteritis, colic, super-purgation, with bloody fecal evacuations, convulsions and death. It acts in the same way whether it is applied externally, injected into the blood, or given internally. Podophyllin must therefore exert its effect after absorption, during excretion from the bowel, and about ten hours are required to produce purgation. The action is exerted mainly on the duodenum, which is intensely inflamed and even ulcerated in poisoning. Podophyllin owes its activity partly to the presence of

bile, which seems to be a solvent for it. It is probable that the intestinal secretions are somewhat augmented. The fecal movements, after medicinal doses of podophyllin, are liquid, often stained with bile, and may be accompanied by some nausea and griping. Since podophyllin is an uncertain purgative, affecting different patients unequally, it should be combined with other agents when a purgative action is desired; preferably calomel and aloes. The time required for the action of these drugs is nearly the same as that necessary for podophyllin. Podophyllin has heretofore been regarded as essentially a cholagogue, but there is no sufficient evidence to warrant this assumption.

Administration.—Podophyllin should be given to dogs in pills; to horses in ball with calomel and aloes, if purgation is desired; or dissolved in liquor potassæ and diluted with water.

Uses.—Podophyllin, clinically, appears to be particularly useful in chronic constipation associated with jaundice and hepatic disorders. The result of its action is said to be more favorable when the fecal discharges are dark colored, whereas calomel is more successful if the evacuations are of a light hue.

SECTION XII.—TANNIC ACID, AND DRUGS CONTAINING IT.

Galla. Nutgall. (U. S. & B. P.)

Synonym.—Galls, E.; gallæ, P. G.; noix de galle, galle de chêne, Fr.; gallafel, G.

An excrescence on Quercus lusitanica Lamarck (nat. ord. Cupuliferæ), caused by the punctures and deposited ova of Cynips tinctoria Olivier.

Habitat.—Levant.

Description.—Subglobular, 1 to 2 Cm. in diameter, externally blackish olive-green or blackish-gray, more or less tuberculated above, the basal portion nearly smooth and contracted into a short stalk, sometimes with a perforation on one side; heavy; fracture horny, yellowish or grayish; in the centre a cavity containing either the partly developed insect, or pulverulent remains left by it; nearly inodorous; taste strongly astringent.

Constituents.—1, (gallo) tannic acid, 60 per cent.; 2, gallic acid, 2-3 per cent.; 3, sugar; 4, resin.

PREPARATIONS.

Unguentum Gallæ. Nutgall Ointment. (U. S. & B. P.)

Nutgall, 20; Ointment, 80. (U. S. P.)

Unguentum Gallæ Cum Opio. (B. P.)

Acidum Tannicum. Tannic Acid. $HC_{14}H_9O_9$. (U. S. & B. P.)

Synonym.—Acidum gallo-tannicum, tanninum, tannin, digallic acid, E.; acid tannique, tannin, Fr.; gerbsäure, tannin, G.

An organic acid obtained from nutgall.

Derivation.—Powdered nutgall is exposed to damp air for 48 hours. It is then treated with water and ether. The water dissolves tannic acid; the ether removes gallic acid, coloring matters and impurities. The mixture is filtered and allowed to stand, when the lower aqueous layer yields tannic acid on evaporation.

Properties.—A light yellowish, amorphous powder, gradually turning darker when exposed to air and light, usually cohering in the form of glistening scales or spongy masses, odorless, or having a faint, characteristic odor, and a strongly astringent taste.

Soluble in about 0.34 part of water and in about 0.23 part of alcohol at 25° C. (77° F.); very soluble in boiling water, and in boiling alcohol; also in about 1 part of glycerin, with the application of a moderate heat; freely soluble in diluted alcohol, sparingly in absolute alcohol; almost insoluble in absolute ether, chloroform, benzene, or petroleum benzin.

Incompatibles.—Alkaloids, alkalies, mineral acids, silver, ferric, lead and antimony salts, gelatin and emulsions.

Dose.—H. & C., ʒ ss.-ʒ ss. (2.-15.); Sh. & Sw., ʒ ss.-i. (2.-4.); D., gr. i.-xv. (.06-1.).

PREPARATIONS.

Collodium Stypticum. Styptic Collodion. (U. S. P.)

Tannic acid, 20; alcohol, 5; ether, 25; collodion, to 100. Made by solution.

Unguentum Acidi Tannici. Ointment of Tannic Acid. (U. S. P.)

Tannic acid, 20; glycerin, 20; ointment, 60.

Glyceritum Acidi Tannici. Glycerite of Tannic Acid. (U. S. & B. P.)

Tannic acid, 20; glycerin, 80. (U. S. P.)

Administration.—Tannic acid is given in solution in aromatic waters, alcohol, syrup, wine, glycerin, and water; also it is exhibited in powder. The drug is used externally in powder, ointment, glycerite, and lotion. Suppositories containing tannic acid are sometimes introduced into the rectum.

Action External.—Tannic acid coagulates albumin, gelatin, and fibrin. It has little effect upon the unbroken skin, but when applied to a raw surface or mucous membrane, it coagulates and dries secretion, and so fills up the mouths of glands, making the tissues harder, denser, and drier. Tannic acid causes a species of "tanning" compatible with life, by occasioning coagulation of the interstitial fluid in the tissues, abstraction of moisture, and contraction of the cells of the part—through the formation of protein tannate. It is the most important astringent principle contained in vegetable drugs. Tannic acid is, moreover, a local styptic or hemostatic in arresting hemorrhage by contraction of the smooth muscles of the vessel walls, by coagulation of the blood, and constriction of the tissues surrounding the blood vessels. Tannic acid causes arrest of leucocyte movements, and diapedesis of the same, at the point of its application. Tannic acid, although a slight local irritant to raw surfaces, exerts a depressing action upon the sensory nerve endings, and is essentially a sedative in inflammatory conditions by causing ischemia. There are several kinds of tannic acid, possessing slightly different chemical and physiological properties. The official tannic acid—gallotannic acid—is contained in nutgall and oak bark, while another variety—catechutannic acid—is found in kino, catechu, etc.

Action Internal.—Tannic acid dries the mouth by closure of glandular (mucous) ducts with coagulated secretion, and by constriction of the surrounding parts. It lessens the flow of mucus and of the digestive juices in the stomach and intestines by the same process. In the stomach tannic acid precipitates protein but as digestion proceeds and peptones are formed, with which tannic acid does not combine, the acid is set free again and acts as an astringent. Large doses irritate the alimentary canal and may create vomiting and diarrhea. Tannic acid is converted into gallic acid in the bowels. Traces appear in the blood and urine as sodium tannate or gallate which has no astringent action. Of the tannic acid swallowed not more than 1 per cent. is excreted in the feces and urine as tannic or gallic acid. All the rest is oxidized in the body. Gallic acid does not coagulate albumin or gelatin and has a very feeble astringent action—like that of any weak acid—so that tannic acid should always be used for a local effect. The remote astringent influence of tannic or gallic acid on the tissues, after absorption in the form of sodium gallate or tannate, is nil. Catechu and kino are

often chosen in place of tannic acid in the treatment of diarrhea, because they are less soluble (than tannic acid) and the contained catechutannic acid comes in contact with the intestinal mucous membrane for a longer time. The salts of tannic acid (tannates) are not astringent.

Uses External.—Tannic acid is a valuable astringent in a great variety of local inflammatory lesions. In the form of the glycerite, tannic acid may be applied advantageously to the skin in moist eczema, and as a remedy for frost bites. It is a useful application for sore and cracked teats. The mouth is painted with the glycerite for the cure of ulcerative or apthous stomatitis. The same preparation is injected into the ear in otorrhea of dogs, and into the vagina to arrest vaginitis and leucorrhea. Pure tannic acid is an excellent agent when dusted upon raw surfaces, ulcers, and sores; and to stop bleeding in slight wounds. An aqueous solution is useful in leucorrhea (2-5 per cent.), in eczema (5-10 per cent.), as a high enema in dysentery (1 per cent.), and to kill ascarides (1-2 per cent.) in the rectum. A one per cent. aqueous solution is sometimes utilized as an inhalation in subacute laryngitis, tracheitis, and bronchitis. Powdered opium and nutgall ointment (1-14), or glycerite of tannin, are serviceable in hemorrhoids and rectal fissures, ulcers, or prolapse of the rectum.

Uses Internal.—Tannic acid is exhibited in powder or solution to arrest bleeding in the stomach. It is a good astringent in diarrhea and an hemostatic in intestinal hemorrhage, given in ball or pill, and often with opium. Tannic acid is an antidote to alkaloids, metallic salts, and tartar emetic, forming comparatively insoluble tannates, which should be removed if possible by evacuation of the stomach.

Tannalbin is a tasteless, odorless, non-irritating, brown powder of tannic acid (50 per cent.), combined with albumin by heat, and only soluble in the pancreatic juice in the bowel. It is more suitable for young animals in diarrhea than is tannic acid.

Dose.—H. & C., 3 i.-iv. (4.-15.); foals & calves, gr. xx.-xl. (1.3-2.6); D. & C., gr. x.-xx. on food.

Tannigen, Tannyl Acetate, $C_{18}H_{14}O_{11}$.

Made by heating tannin and acetic anhydride in the presence of glacial acetic acid. Occurs as a light gray, odorless, tasteless powder. Insoluble in water but soluble in alcohol and alkalies. It passes unchanged through the stomach into the bowels where it acts as an astringent in the presence of the solvent action of the alkaline juices. It is useful in diarrhea and dysentery in young animals. Foals and

calves take gr. xxx. (2.) with food. The advantage of both of these preparations over tannic acid depends upon the fact that they do not irritate the stomach, passing through it unchanged, and being only dissolved by the alkaline intestinal juices.

Acidum Gallicum. Gallic Acid. $HC_7H_5O_5 + H_2O$. (U. S. & B. P.)

Synonym.—Acide gallique, Fr.; gallussäure, G.

An organic acid, usually prepared from tannic acid.

Derivation.—Made by exposure of paste of nutgall and water to the air for a month, when tannic acid undergoes hydration (tannic acid) $HC_{14}H_9O_9 + H_2O = 2\ HC_7H_5O_5$ (gallic acid). The liquid is then expressed from the paste and the residue is boiled with distilled water and filtered, when hot, through animal charcoal. Gallic acid crystallizes out from the filtrate.

Properties.—White, or pale fawn-colored, silky, interlaced needles or triclinic prisms; odorless; having an astringent or slightly acidulous taste; permanent in the air. Soluble in 83.7 parts of water, and in 4.14 parts of alcohol; in 40 parts of ether, and in 12 parts of glycerin. Very slightly soluble in chloroform, benzol, or benzin.

Incompatibles.—Metallic salts and spirit of nitrous ether.

Dose.—H. & C., ʒ ii.-ʒ ss. (8.-15.); Sh. & Sw., ʒ ss.-i. (2.-4.); D., gr. v.-xx. (.3-1.3).

Action and Uses.—Experiments show that gallic acid has a very feeble astringent action when locally applied and tannic acid should always be preferred. It is absorbed and transformed into sodium gallate and exists in this form in the tissues.

Since sodium gallate has no remote astringent action its use by the mouth for such a purpose is without scientific basis, although successful results are alleged to have followed its administration in the treatment of hemorrhage from the lungs, uterus and kidneys, and in polyuria, albuminuria, bronchorrhea, leucorrhea, and excessive sweating.

Pyrogallol. Pyrogallol. $C_6H_3(OH)_3$. (U. S. P.)

Synonym.—Pyrogallic acid.

Derivation.—A triatomic phenol obtained chiefly by the dry distillation of gallic acid, $HC_7H_5O_5 = C_6H_3(OH)_3 + CO_2$.

Properties.—Light, white, shining laminæ, or fine needles; odorless, and having a bitter taste; acquiring a gray or darker tint

on exposure to the air and light. Soluble in 1.6 parts of water, and in 1 part of alcohol; also soluble in 1.1 parts of ether.

Action and Uses.—Pyrogallol is an excellent agent for the treatment of chronic psoriasis and for ringworm. An ointment containing an amount of pyrogallol, varying from gr. x.-ʒ i. to the ounce of lard, is commonly employed. Toxic symptoms may follow its extensive application.

Quercus. White Oak. (U. S. P.)

[Quercus Alba, Pharm. 1890.]

The dried bark of *Quercus alba* Linné (Fam. *Cupuliferæ*), collected from trunks or branches ten to twenty-five years of age, and deprived of the periderm.

Synonym.—Quercus cortex, B. P.; cortex quercus, écorce de chêne, Fr.; eichenrinde, G.

Habitat.—North America, in woods.

Description.—In nearly flat pieces, 2 to 10 Mm. thick; externally light brown, becoming darker with age, rough-fibrous; fracture uneven, coarsely fibrous; odor distinct; taste strongly astringent; not tingeing the saliva yellow when chewed.

Constituents.—1, quercitannic acid, 6 to 11 per cent.; 2, a bitter principle, quercin; 3, resin; 4, a sugar, quercite.

Dose.—H., ʒ ss.-i. (15.-30.); C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ i-ii. (4.-8.); D., gr. x.-xxx. (.6-2.).

Preparation.—Fluidextractum Quercus (U. S. P.)—H. ʒ ss. (15.). D., ♏15 (1.).

Action and Uses.—White oak bark is identical in action with tannic acid, but the latter is preferable for internal use. Oak bark is a cheap substitute for tannic acid applied externally in poultices, infusions, and decoctions, as an astringent. It is administered internally in infusion, or decoction (1-8), in diarrhea and dysentery. The infusion may be given in gruel and combined with ginger, opium and alcohol in the treatment of "scouring" in foals and calves.

Catechu. Catechu. (B. P.).

Synonym.—Catechu pallidum, catechu nigrum, terra japonica, cutch, E.; cachou, Fr.; katechu, pegucatechu, G.

Gambir. Gambir. (U. S. P.)

[To replace Catechu, Pharm. 1890].

An extract prepared from the leaves and twigs of *Ourouparia Gambir* (Hunter) Baillon (Fam. *Rubiacoe*).

Description.—Irregular masses, or cubes about 25 Mm. in diameter; externally reddish-brown, pale brownish-gray, or light brown; fracture dull-earthy, friable, crystalline; inodorous, bitterish, very astringent, with a sweetish after-taste; free from starch. Not less than 70 per cent. should be soluble in alcohol.

Constituents.—1, catechutannic acid (about 45 per cent.) is the active principle; it is converted into the isomeric inactive catechuic acid, or catechin ($C_{21}H_{20}O_9 + 5\ H_2O$), by the saliva and by boiling, a red color being developed. There is also (2) pyrocatechin or catechol.

Incompatibles.—Metallic salts, alkalies, and gelatin.

Dose.—H., ʒ ss.-i. (15.-30.); C., ʒ i.-ii. (30.-60.); Sh. & Sw., 3 i.-ii. (4.-8.); D., gr. v.-xxx. (.3-2.).

PREPARATIONS.

Tinctura Catechu. (B. P.)

Dose.—H. & C., ʒ i.-ii. (30.-60.); Foals, Calves and Sheep, ʒ ss.-i. (15.-30.); D., 3 ss.-ii. (2.-8.).

Pulvis Catechu Compositus. Kino, Rhatany and Catechu. (B. P.)

Dose.—Same as catechu.

Tinctura Gambir Composita. Compound Tincture of Gambir.

Gambir (a species of catechu), 50; cinnamon, 25; alcohol to make 1000. (U. S. P.)

Now replaces the compound tincture of catechu and possesses the same action and is given in the same doses as the tincture.

Administration.—The compound tincture, or an infusion (made by pouring boiling water over catechu, digesting for an hour, and straining), and the powder, are employed internally. The powder is given in flour gruel. The powder, or an infusion of any strength may be applied externally.

Catechu is represented in the B. P. by catechu pallidum, an extract of the leaves and young shoots of Uncaria gambier, Indian Archipelago. It occurs in brown cubes, about an inch square, and possesses a bitter, astringent taste. It is employed in the same doses and for the same purposes as catechu.

Action and Uses.—The action of catechu is exactly like that of tannic acid. The latter is preferable for external use on account of its greater solubility and astringency. Catechu acts more slowly and persistently in the digestive tract, by virtue of its tardy solubility, and is a useful remedy in diarrhea, particularly in that of a watery or serous nature. It is frequently prescribed in this disorder with other synergistic agents, as opium, ginger and chalk. Finlay Dun recommends the following combination: Catechu, prepared chalk, and ginger, each three ounces; powdered opium, six drachms. Divide into eight balls, for horses; into six doses suspended in starch gruel for cattle; and into eight or ten doses (given in gruel) for calves or sheep. The compound tincture of gambir with laudanum is an equally suitable combination for all animals with diarrhea, given in drench. If there is much mucus in the fecal discharges, showing a catarrhal state of the intestinal mucous membrane, it is advisable to order oil, salts, or calomel before locking up the bowels with an astringent. Catechu has been given internally in dysentery, and to stop uterine and other hemorrhages.

Kino. Kino. (U. S. & B. P.)

The inspissated juice of Pterocarpus Marsupium Roxburgh (nat. ord. Leguminosæ).

Habitat.—East Indies. Kino, indigenous in the West Indies, is occasionally imported here.

Properties.—Small, angular, dark brownish-red, shining pieces; brittle, in thin layers, ruby-red and transparent; inodorous, very astringent and sweetish, tingeing the saliva deep red. Soluble in alcohol; nearly insoluble in ether, and only slightly soluble in cold water.

Constituents.—The most important is (1) kinotannic acid ($C_{18}H_{18}O_8$, 75 per cent.), resembling catechu-tannic acid, but not identical with it. There are also: 2, kinoin, a crystalline, neutral substance; 3, pyrocatechin, $C_6H_4(OH)_2$; 4, gum; 5, pectin; 6, kino-red, formed by oxidation from kinotannic acid.

Incompatibles.—Mineral acids, metallic salts, strong solutions of alkaloids, alkalies, and gelatin.

Dose.—H., ʒ ss.-i. (15.-30.); C., ʒ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. v.-xxx. (.3-2.).

PREPARATIONS.

Tinctura Kino. Tincture of Kino. (U. S. & B. P.)

Prepared by maceration and filtration of kino, 150, and purified talc, 10; with glycerin, 150; water and alcohol to make 1000. (U. S. P.)

Dose.—H. & C., ʒ i.-ii. (30.-60.); Foals, Calves and Sheep, ʒ ss.-i. (15.-30.); D., 3 ss.-ii. (2.-8.).

Pulvis Kino Compositus. Compound Powder of Kino. (B. P.)

(Pulv. cinnamon, 4 grs.; kino, 15 grs.; opium, 1 gr.)

Dose.—Dog, 1 powder; Foals and Calves, 4 powders.

Administration.—Kino may be given in ball, powder, infusion (1-32), or tincture.

Action and Uses.—The physiological actions and therapeutics of kino are nearly similar to those of catechu. The gum and pectin contained in kino renders its effect milder and more soothing to mucous membranes. Aqueous solutions gelatinize on standing, on account of the gum in them. The drug is prescribed chiefly in serous diarrhea, and also is occasionally exhibited in dysentery and internal hemorrhages.

Krameria. Krameria. (U. S. P.)

Synonym.—Krameriæ radix, B. P.; radix rhatanhiæ, rhatany root, E.; radix ratanhæ, P. G.; ratanhia, Fr.; ratanhawurzel, G.

The dried root of *Krameria triandra* Ruiz and Pavon (Peruvian Krameria), *Krameria Ixina* Linné (Savanilla Krameria) or of *Krameria argentea* Martius (Para or Brazilian Krameria) (Fam. *Krameriaceæ*).

Habitat.—Peru and Brazil.

Description.—Peruvian Krameria.—Root-branches several or many, usually attached to a short, hard, and woody tap-root, which is 1.5 to 4 Cm. thick, roughly fissured, and supporting a knotty, several- to many-headed crown; roots of variable length, rarely exceeding 50 Cm. and usually less than 1 Cm. thick, cylindrical, flexuous or wavy, very flexible; externally light red-brown, more or less marked with dark, scaly patches, especially upward, otherwise smoothish, devoid of transverse fissures; fracture tough and splintery, the pinkish-brown bark occupying less than one-third of the radius, the wood yellowish or pinkish-white, finely radiate; inodorous and of a very astringent taste.

Savanilla and Brazilian Kramerias.—Branches usually occurring detached from the tap-root and crown, less flexuous than those last described, externally of a purple-brown or chocolate brown, and with numerous transverse cracks or fissures; fracture less tough than that of Peruvian Krameria, the bark and wood both darker, the bark occupying two-fifths or more of the radius, the taste more astringent than that of Peruvian Krameria.

Constituents.—The chief principle is (1) kramero-tannic acid, $C_{54}H_{24}O_{21}$, about 20 per cent. There are also: 2, rhatanin; 3, rhatanic-red ($C_{26}H_{22}O_{11}$), the coloring matter.

Incompatibles.—Metallic salts, alkalies, gelatin, and lime water.

Dose.—H., ℥ ss.-i. (15.-30.); C., ℥ i.-ii. (30.-60.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., gr. v.-xxx. (.3-2.).

PREPARATIONS.

Fluidextractum Krameriæ. Fluidextract of Krameria. (U. S. P.)

Made by maceration and percolation of krameria with glycerin and diluted alcohol, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—Same as krameria.

Extractum Krameriæ. Extract of Krameria. (U. S. & B. P.)

Made by filtration, and evaporation of a cold, aqueous infusion to dryness.

Dose.—H. & C., ʒ ii.-iii. (8.-12.); Sh. & Sw., gr.xxx.-xl. (2.-2.6); D., gr.v.-x. (.3-.6).

Tinctura Krameriæ. Tincture of Krameria. (U. S. & B. P.)

Made by maceration and percolation of krameria, 200; with diluted alcohol to 1000. (U. S. P.)

Dose.—H. & C., ℥ i.-ii. (30.-60.) Foals, Calves and Sheep, ℥ ss.-i. (15.-30.); D., ʒ ss.-ii. (2.-8.).

Action and Uses.—Krameria and its preparations nearly resemble catechu and kino in all respects as astringents. The fluid extract is a serviceable preparation in watery diarrhea, and in arresting hemorrhage from the stomach and bowels. An infusion (1-20, B. P.) is an efficient remedy for leucorrhea when injected into the vagina. The powdered extract is blown into the nostrils, or applied to the rectum to stop bleeding in these parts.

Hæmatoxylon. Hematoxylon.

Synonym.—Hematoxyli lignum, B. P.; logwood, E.; lignum campechianum, P. G.; lignum cæruleum—bois de campêche, bois d'inde, bois de sang, Fr.; blauholz, campecheholz, G.

The heart wood of Hæmatoxylon Campechianum Linné (nat. ord. Leguminosæ.)

Habitat.—Central America; naturalized in the West Indies.

Description.—Usually in small chips, reddish-brown, the freshly cut surface dark yellowish-red; on transverse section the wood showing medullary rays which are four cells wide; odor faint, agreeable; taste sweetish, astringent.

Hematoxylon imparts to water containing a little acid a yellowish color, which is changed to purple or violet-red by alkalies.

When the surface has a greenish metallic lustre, the wood has undergone fermentation and should be rejected.

Constituents.—The most important is (1) tannic acid. There are also; 2, hematoxylin, $C_{16}H_{14}O_6$ (12 per cent.), a coloring matter, but in nearly colorless crystals when pure. It turns red on exposure to light, and solutions are used to stain pathological specimens; 3, hematein, $C_{16}H_{12}O_6$, formed hematoxylin by oxidation, and possessing a green, metallic lustre.

Incompatibles.—Lime water, and tartar emetic, with metallic salts, form a blue compound.

PREPARATION.

Extractum Hæmatoxyli. Extract of Hæmatoxylon. (U. S. & B. P.)

Made by boiling in water, straining, and evaporating to dryness.

Dose.—H. & C., 3 ss.-iv. (2.-15.); Sh. & Sw., 3 ss.-i. (2.-4.); D., gr.v.-xv. (.3-1.).

A non-official fluidextract is often found in commerce.

Dose.—Three times that of extract.

Action and Uses.—Hematoxylon is a mild astringent, coloring the feces and urine red during its elimination. The extract is given in diarrhea of young animals, and may be combined for this purpose with aromatic sulphuric acid, ginger, chalk and opium. It is also employed internally in dysentery, atonic indigestion, and in leucorrhea. The decoction (1-16, B. P.) may be exhibited in Oss.-i. doses to the larger animals; in ʒ i.-ii. doses to smaller patients.

Hamamelidis Folia. Hamamelis Leaves. (U. S. & B. P.)

Synonym.—Witch-hazel.

The leaves of Hamamelis virginiana Linné (nat. ord. Hamamelidaceæ), collected in autumn.

Description.—Short, petiolate, about 10 Cm. long, obovate or oval, slightly heart-shaped and oblique at the base, sinuate-toothed, thickish, nearly smooth; inodorous; taste astringent and bitter.

Hamamelidas Cortex. Hamamelis Bark. (U. S. P.)

The bark and twigs of *Hamamelis virginiana* Linné (Fam. *Hamamelidaceæ*).

Constituents.—The most important principle is (1) tannic acid, 8 per cent.; there are also: (2) a bitter substance, and (3) a resin.

PREPARATIONS.

Fluidextractum Hamamelidis Foliorum.
Fluidextract of Hamamelis Leaves. (U. S. P.)

Made by maceration and percolation with alcohol, glycerin and water, and evaporation, so that 1 cc. = 1 gm. of the crude drug.

Dose.—H. & C., ʒ i.-ii. (30.-60.); D., ʒ ss.-ii. (2.-8.).

Extractum Hamamelidis Liquidum. (B. P.)

Dose.—Same as fluidextract.

Aqua Hamamelidis. (U. S. P.)

Takes place of the proprietary extracts and consists of the bark macerated in water and distilled, alcohol being added to the distillate.

Dose.—Double that of fluidextract.

Unguentum Hamamelidis. (B. P.)

Action and Uses.—Hamamelis is apparently physiologically inert, as shown by experiments on healthy animals. It nevertheless possesses considerable medicinal virtue as an astringent and styptic. Witch-hazel is a valuable agent, applied externally, to stop venous oozing in wounds, and to reduce swelling and pain of bruises and sores. The fluidextract may be diluted with 8, or less, parts of water, for these purposes; or the B. P. ointment (1-10) may be employed. Internally hamamelis is useful in diarrhea and mucous discharges. It arrests hemorrhage from the uterus, kidneys, lungs and digestive tract; sometimes in a surprising manner. The fluidextract is a successful hemostatic in bleeding from the bladder or rectum (piles) when injected (1-8) into these parts. It lessens soreness and swelling of blind piles—with an equal part of glycerin and a little starch—and the same preparation is beneficial in eczema, pruritus, and cutaneous irritations. The clear, colorless proprietary extracts—now the aqua (U. S. P.) takes their place—are often more efficient externally and internally (in the same doses) than the official fluidextract.

SECTION XIII.—VEGETABLE DEMULCENTS.

Oleum Olivæ. Olive Oil. (U. S. & B. P.)

Synonym.—Sweet oil, E.; oleum olivarum, P. G.; huile d'olive, Fr.; oilvenöl, G.

A fixed oil expressed from the ripe fruit of Olea europœa Linné

(nat. ord. Oleaceæ). It should be kept in well stoppered bottles in a cool place.

Habitat.—Southern Europe and Asia.

Properties.—A pale yellow, or light greenish-yellow, oily liquid, having a slightly peculiar odor, and a nutty oleaginous taste, with a faintly acrid after-taste. Spec. gr. 0.910 to 0.915. Very sparingly soluble in alcohol, but readily soluble in ether, chloroform, or carbon disulphide. Very frequently adulterated with cotton seed, or other seed oils, which probably are of equal medicinal value, however.

Constituents.—1, olein, C_3H_5 $(C_{18}H_{33}O_2)_3$, 72 per cent., a fluid oil, a combination of oleic acid ($HC_{18}H_{33}O_2$) and glyceryl; 2, palmitin, C_3H_5 $(C_{16}H_{31}O_2)_3$, about 28 per cent., a combination of palmitic acid ($HC_{16}H_{31}O_2$) and glyceryl; and (3) arachin, $C_{20}H_{40}O_2$.

Dose.—Laxative.—H. & C., Oi.-ii (500.-1000.); D., ℥ ii.-iv. (60.-120.).

Oleum Gossypii Seminis. Cotton Seed Oil. (U. S. P.)

A fixed oil expressed from the seed of Gossypium herbaceum Linné and of other species of Gossypium (nat. ord. Malvaceæ), and subsequently purified.

Habitat.—S. United States and other semi-tropical countries; cultivated.

Properties.—A pale yellow, oily liquid, without odor, and having a bland, nut-like taste. Spec. gr. 0.915 to 0.921. Very sparingly soluble in alcohol but readily soluble in ether, chloroform, or carbon disulphide.

Constituents.—1, olein; 2, palmitin; 3, coloring matter.

Dose.—Same as that of olive oil.

Action and Uses.—Olive oil is in common use as an emollient in burns and skin irritation. It assists in the performance of massage for sprains and bruises. Cotton seed oil has superseded it in liniments, as a matter of economy. Administered internally, sweet oil (with an equal part of castor oil) is a useful laxative for dogs. Linseed oil is more frequently given to the larger animals. An enema of ½ pint, or more, of olive oil is serviceable in softening hard fecal masses in dogs, and should be followed by the use of warm soap suds.

Sweet oil is a food, but is rarely used as such. Like other bland oils, it improves the nutrition of the bronchial mucous membrane in subacute or chronic bronchitis, and is of considerable benefit in these disorders, but inferior to cod liver oil or linseed oil. Olive oil is an efficient demulcent in inflamed conditions of the alimentary

tract, and in poisoning by irritants. Large quantities form soap-like masses,—with the alkaline intestinal juices,—which have been mistaken for gall stones. Cotton seed oil is of equal therapeutic value with sweet oil.

Sapo. Soap.

Synonym.—Sapo duras, B. P.; hard soap, white castile soap, E.; savon, Fr.; seife, G.

Derivation.—Soap is made by boiling olive oil with a solution of caustic soda, $C_3H_5(C_{18}H_{33}O_2)_3$ (olein) + 3 NaOH = 3 $NaC_{18}H_{33}O_2$ (sodium oleate or soap) + $C_3H_5(OH)_3$ (glycerin).

Properties.—A white, or whitish solid, hard, yet easily cut when fresh; having a faint, peculiar odor free from rancidity; a disagreeable alkaline taste, and an alkaline reaction. Soluble in water and in alcohol; more readily with the aid of heat.

PREPARATIONS.

Linimentum Saponis. Soap Liniment. (U. S. & B. P.)

Synonym.—Opodeldoc. Lin. sapo. camph.

Soap, 60; camphor, 45; oil of rosemary, 10; alcohol, 725; water to make 1000. Made by solution, agitation and filtration. (U. S. P.)

Emplastrum Saponis. Soap Plaster. (U. S. & B. P.)

Soap, 10; lead plaster, 90; made by solution in water, 100; and evaporation.

Sapo Mollis. Soft Soap. (U. S. & B. P.)

Synonym.—Potassium oleate, sapo viridis, green soap.

A soap prepared from potassa and a fixed oil.

Derivation.—Heat linseed oil, 400, to 140° F. Dissolve potassium hydroxide, 95, in water, 450; add alcohol, 40; and stir the mixture into the oil at the same temperature until it is soluble in boiling water without the separation of oily drops.

Properties.—A soft, yellowish-brown, unctuous mass, having a characteristic odor and an alkaline taste. Soluble in about 5 parts of hot water; also in 2 parts of alcohol without leaving more than 3 per cent. of insoluble residue.

PREPARATION.

Linimentum Saponis Mollis. Liniment of Soft Soap. (U. S. P.)

Synonym.—Tinctura saponis viridis.

Soft soap, 650; oil of lavender flowers, 20; alcohol to make 1000. Made by solution and filtration.

Castile soap is the best example of a pure soap. Mottled castile soap contains iron as the coloring matter. The household "soft soap" is not sapo mollis, but is made of all kinds of rancid fats and is generally unfit for medicinal use. Yellow laundry soap owes its color to rosin. Super-fatted soaps are of neutral reaction and unirritating. They are used as a basis for medicinal soaps containing tar, carbolic acid, etc.

Action and Uses.—Most soaps are alkaline. Soap is a detergent or cleansing agent. The lather mechanically removes dirt, while the alkalinity assists in the removal of grease, dead epidermis, and sebaceous matter from the skin. The caustic alkali contained in soap relieves itching and is stimulating to the skin; so much so, that cheap soaps are harmful in normal conditions of the integument.

Liniment of soft soap is frequently employed in chronic eczema and psoriasis, to remove scales and crusts; to stimulate the parts; and to quiet itching. It should be rubbed smartly into the skin, washed off, and followed by the application of a suitable ointment. Gauze saturated with soap suds (soap suds poultice) is an excellent agency to cause the exfoliation of the epidermis in patches of old scaly eczema or psoriasis, when applied for several hours. Soft soap, oil of cade, and alcohol, equal parts, are recommended as a useful preparation for the treatment of chronic eczema and pruritus. The application of soap and water is a necessary preliminary to the employment of a vesicating ointment, or parasiticide, since it cleanses the skin, and, by removing epidermis, exposes the burrows of acari in mange and scab. Soap liniment is a favorite remedy for sprains and bruises. If a more stimulating action is desirable, it is advisable to combine oil of turpentine or water of ammonia with it. If an anodyne effect is indicated, tincture of aconite or opium is added.

Chafing of the skin produced by harness, should be treated by washing the skin with soap and water, and then by dusting with zinc oxide and starch, equal parts. Sapo mollis, together with an equal amount of flour of mustard, forms a most satisfactory cleansing and disinfectant mixture for the hands of the operating surgeon when employed in the same manner as ordinary soap. Soap may also be used as a lubricating agent for the hands or instruments in making examinations. Soap is a useful excipient for balls, pills, and plasters, and it is a constituent of liniments.

Soap is employed both as a qualitative and quantitive test for hard water. This contains salts of the alkaline earth metals, as sulphates and carbonates of magnesium and calcium. Soap is de-

composed by these salts, and insoluble soaps, *i.e.*, calcium and magnesium stearate, are precipitated. The free alkali of the soap is then converted into insoluble sulphates and carbonates. These reactions produce a milky precipitate when a solution of soap is added to hard water.

Internally soap is an antacid and somewhat irritating, and may occasion vomiting and stimulation of intestinal peristalsis. These actions are taken advantage of in emergencies, when it may be given to dogs as an emetic, or to all animals in poisoning by acids. A piece of soap, when shaped by the hands into a conical form, dipped an instant into water, and introduced into the rectum, is one of the best agents for moving the bowels in the case of puppies and all young animals. Enemata of soap suds are in every day use. A mixture of sapo mollis, molasses, and water, in varying proportions, is a more efficient preparation. Oil of turpentine may be added in flatulence.

GLYCERINUM. Glycerin. $C_3H_5(OH)_3$. (U. S. & B. P.)

Synonym.—Glycerine, glycerole, E.; glycerine, Fr.; glycerin, œlsüss, G.; glycerinum, P. G.

Derivation.—A liquid obtained by the decomposition of vegetable or animal fats or fixed oils, and containing not less than 95 per cent. of absolute glycerole, a triatomic alcohol. It occurs as a bye-product in the manufacture of soap, but is made chiefly from palm oil by the action of superheated steam at a temperature of about 600° F.

Properties.—A clear, colorless liquid, of a thick, syrupy consistence, oily to the touch, odorless, very sweet and slightly warm to the taste. When exposed to the air it absorbs moisture. Spec. gr. not less than 1.246. Soluble in all proportions in water or alcohol; also soluble in a mixture of 3 parts of alcohol and 1 part of ether, but insoluble in ether, chloroform, carbon disulphide, benzin, benzol, and fixed and volatile oils. Reaction neutral. Glycerin is a solvent for alkaloids, digestive ferments, fixed alkalies, bromine, iodine, tannin, extracts, salicin, borax, boric acid, carbolic acid, etc.

Dose.—H. & C., ℥ i. (30.); D., ʒ ss.-i. (2.-4.).

PREPARATIONS.

Glyceritum Amyli. Glycerite of Starch. (U. S. & B. P.)

Starch, 10; water, 10; glycerin, 80. Made by solution with heat.

There are also official glycerites of phenol (1-5), of tannic acid (1-4), of boroglycerin (31 per cent.), of hydrastis, and of phosphates of iron, quinine and strychnine (gr. 1/15 to 1 c.c.).

Suppositoria Glycerini. Suppositories of Glycerin. (U. S. P.)

Glycerin, 30 gm.; monohydrated sodium carbonate, 0.5 gm.; stearic acid, 2.0 gm. Made by solution with heat and moulded into ten suppositories containing 3 gm. each.

Action External.—Glycerin is hydroscopic, emollient, sometimes parasiticidal, and antiseptic. It does not evaporate or become rancid. The chief medicinal value of glycerin depends upon its affinity for water, so that (in solution) it keeps moist the surface to which it is applied. Pure glycerin is, however, slightly irritant to the skin and may cause some inflammation of raw surfaces and mucous membranes on account of withdrawal of water from the tissues. It should therefore be diluted with water for most therapeutic purposes.

Action Internal.—Glycerin is absorbed and oxidized in the body, and possesses some value as a carbohydrous food. It may give rise to a substance in the urine which reduces cupric oxide and renders the sugar test positive. It is somewhat antiseptic in the digestive tract, and appears to inhibit the formation of glycogen in the liver in some cases of glycosuria. Large doses are irritant and slightly purgative. Enormous quantities cause poisoning in animals, with the production of hemoglobinuria, glomerulonephritis, muscular weakness, dryness of the mucous membranes, restlessness, collapse, tremor, convulsions, coma and death.

Uses External.—These are manifold. It is largely employed in lotions, ointments, and as a vehicle for the substances of which it is a solvent. Glycerite of starch is a successful remedy for rough, dry skin, and scaly eczema. Glycerite of carbolic acid is an appropriate application for fetid sores and ulcers, and, diluted with an equal part of glycerin, will destroy the acari of mange and scab. It should be used with caution to prevent poisoning. Glycerite of boroglycerin is an excellent preparation for the treatment of apthous stomatitis and thrush. In dryness of the meatus, and in canker of the ear (otorrhea) in dogs, a mixture of tincture of iodine, 1 part, and glycerin, 4 parts, is recommended. Scratches and cracked heels of horses, fissured and excoriated surfaces, and erythema, are successfully treated with the following prescription:

℞

Tinc. Opii	ʒ i.
Liq. Plumbi Subacetat	ʒ iv.
Glycerini	ʒ ii.
Aquæ	ad. ʒ viii.

M.

S. Apply externally.

Uses Internal.—Glycerin is employed as an excipient for balls and pills, and as a vehicle for nauseous and irritating drugs. It is not a valuable remedy for internal use, but is sometimes given with the food to prevent intestinal fermentation and relieve flatulence. It may prove curative in cases of glycosuria; and in trichinosis when given by the mouth, and in high rectal injections after active purgation. Glycerin is a useful addition to cough mixtures in moistening and soothing the throat, and in not interfering with digestion. When injected into the rectum in quantities of ℥ iv.-vi. for horses, or ℥ ss.-i. for dogs, it often causes prompt evacuation of the lower bowel. The suppositories may be employed in canine practice.

Glycyrrhiza. Glycyrrhiza.

Synonym.—Glycyrrhizæ radix, B. P.; liquorice or licorice root, E.; réglisse, bois de réglisse, boix doux, racine douce, Fr.; spanisches süssholz, spanische süssholz-wurzel, G.

The root of Glycyrrhiza glabra Linné (Spanish licorice) or of the variety glandulifera (Waldstein et Kittaibel) (Russian licorice), (nat. ord. Leguminosæ).

Habitat.—S. Europe and W. Asia; cultivated.

Description.—Spanish Licorice.—Cylindrical, usually cut into pieces 14 to 20 Cm. or more long, 5 to 15 Mm. thick; longitudinally wrinkled, grayish-brown or dark-brown, pliable; fracture coarsely fibrous; internally tawny-yellow; bark 1 to 3 Mm. thick; wood porous, in narrow wedges; odor slight; taste sweetish and slightly acrid.

Russian Licorice.—Somewhat tapering, frequently 1 M. or more in length, 1 to 5 Cm. in diameter, deprived of the outer corky layer, when it is externally pale yellow; internally of a lighter yellow; wood rather soft; taste less sweet than that of the Spanish Licorice. Any blackened, knotty, bitter portions should be removed.

Constituents.—1, a yellow, sweet, amorphous glucoside, glycyrrhizin ($C_{24}H_{36}O_9$), about 6 per cent., which with acids yields a bitter substance, glycyrrhetin, and glucose; 2, glycyramin; 3, asparagin, about 3 per cent.; 4, an acrid resin; 5, starch; 6, glucose.

PREPARATIONS.

Fluidextractum Glycyrrhizæ. Fluidextract of Glycyrrhiza. (U. S. P.)

Made by maceration and percolation with water of ammonia, alcohol and water, and evaporation, so that 1 cc. = 1 gm. of the crude drug. Dose of the root or fluidextract is unimportant.

Extractum Glycyrrhizæ Liquidum. (B. P.)

Dose unimportant.

Pulvis Glycyrrhizae Compositus. (U. S. P.) (See p. 517.)

Action and Uses.—Licorice is demulcent and slightly laxative. The powdered root is employed as an excipient in making electuaries, since it is soothing to the throat. It is also used as an excipient in the preparation of balls, and more or less successfully conceals, in the form of the fluidextract, the taste of aloes, cascara sagrada, ammonium chloride, turpentine, hyoscyamus and quinine sulphate.

Linum. Linseed. (U. S. & B. P.)

Synonym.—Flaxseed, E.; semence de lin, Fr.; leinsamen, flachssamen, G.; semen lini, P. G.

The ripe seed of Linum usitatissimum Linné (nat. ord. Linaceæ).

Habitat.—Most temperate climates.

Description.—Ovate or oblong-lanceolate, flattened, 4 or 5 Mm. long, obliquely pointed at one end; externally chestnut-brown, very smooth and glossy, covered with transparent, mucilaginous outer wall which swells in water; embryo white or greenish, with two large, plano-convex and oily cotyledons, embedded in thin perisperm; odor slight; taste mucilaginous, oily.

Ground Linseed (Linseed Meal or Flaxseed Meal) should be recently prepared and free from unpleasant or rancid odor. It is a grayish-yellow powder containing brownish fragments.

Constituents.—1, linseed oil, 30 to 35 per cent. in the embryo; 2, gum, 15 per cent. in the epidermis; 3, proteids, 25 per cent.; 4, a trace of amygdalin.

Action and Uses.—Linseed is a food. Oil cake or linseed cake from which the oil has been expressed, is exceedingly rich in protein (25-30 per cent.), and is also richer in fat (10 per cent.) than most foods. Cottonseed meal, which contains considerably more protein and fat, is more frequently employed in the United States. Gruel made from crushed linseed meal cake, or linseed meal, is useful as a restorative in all animals recovering from acute and debilitating diseases. The cake (1 lb.), or a pint of cottonseed meal per diem, is a good addition to the ordinary fodder for horses suffering from malnutrition, with rough staring coats and dry skin, and for those affected with "broken wind." Gruel of linseed meal or cake is also serviceable for calves or lambs when reared on skimmed milk or other poor food. Linseed tea, made by steeping 1 part of whole linseed in 20

parts, by weight, of boiling water, for 1-4 hours, followed by straining, is a valuable demulcent preparation in pharyngitis, bronchitis, gastro-enteritis, and is possibly useful in acute cystitis and nephritis. It may be given in any amount which an animal will take voluntarily. The mucilage contained in linseed tea cannot be carried through the blood and eliminated by the kidneys, so that it must act by virtue of the water contained in it and perhaps by some intrinsic diuretic property.

The addition of a few drachms of gum arabic to the quart of linseed tea will improve the demulcent action. Linseed, linseed meal or farina lini is the best substance to use in the preparation of poultices. It should be mixed with an equal quantity of bran, when the poultice is applied directly to the part. If the poultice is enclosed in a bag, the outside should be oiled to prevent its sticking to the skin. Linseed meal, mixed with an equal amount of molasses, forms a common excipient for ball masses. Linseed tea, made thicker than usual, is a good local application in irritation of the rectum, or vagina.

Acacia. Acacia.

Synonym.—Acaciæ gummi, B. P.; gum arabic, E.; gomme arabigue, Fr.; arabisches gummi, G.

A gummy exudation from Acacia Senegal Willdenow and other species of Acacia (nat. ord. Leguminosæ).

Habitat.—N., E., and W. Africa.

Properties.—In roundish tears of various sizes, or broken into angular fragments; whitish or yellowish-white, translucent; very brittle, with a glass-like, sometimes iridescent fracture; nearly inodorous; taste insipid, mucilaginous; insoluble in alcohol; slowly and completely soluble in water, forming an odorless, mucilaginous liquid.

Constituents.—Arabin or arabic acid ($C_{12}H_{22}O_{11}$), in combination with about 3 per cent. of magnesium, potassium and calcium.

Incompatibles.—Alcohol, ferric salts, lead subacetate, borax, and sulphuric acid.

Preparations.—Mucilago acaciæ, U. S. & B. P. (34 per cent., U. S. P.), and syrupus acaciæ, U. S. P. (10 per cent.)

Dose.—Ad lib.

Action and Uses.—Gum arabic is but slightly nutritious. It is a useful demulcent in covering and protecting inflamed mucous membranes of the upper respiratory and digestive tracts. It may be given freely in water, but large quantities may undergo fermentation and cause indigestion and diarrhea. A 10 per cent. aqueous solu-

tion is sometimes injected into the bladder, vagina or rectum in inflammation of these parts. Acacia is chiefly of value in medicine for the preparation of mixtures, emulsions, pills, balls and electuaries. About ʒ iii. of mucilago acaciæ are required to suspend ʒ i. of oil or resinous tincture. Acacia is sometimes prescribed in genito-urinary irritation. Animals will voluntarily drink aqueous solutions.

Tragacantha. Tragacanth. (U. S. & B. P.)

Synonym.—Gomme adragante, Fr.

A gummy exudation from Astragalus gummifer Labillardière, and from other species of Astragalus (nat. ord. Leguminosæ).

Habitat.—Asia Minor.

Properties.—In ribbon-shaped bands varying in size and from 1 to 3 Mm. thick, or in irregular pieces of the same, long and linear, straight or spirally twisted; externally whitish, marked by more or less pronounced longitudinal or excentric lines or ridges: translucent, horny, fracture short, tough, rendered more easily pulverizable by a heat of 50° C. (122° F.).

On treating Tragacanth with 50 parts of water, it swells and gradually forms a cloudy, gelatinous mass, which, on warming with solution of sodium hydroxide on a water-bath, becomes yellow and is tinged blue on the addition of iodine.

Constituents.—1, arabin, 53.3 per cent., not identical with arabin of acacia, however; 2, bassorin ($C_6H_{10}O_5$), 33 per cent., a gum, swells up with water but does not dissolve; 3, starch; 4, ash.

PREPARATION.

Mucilago Tragacanthæ. Mucilage of Tragacanth. (U. S. & B. P.)

Tragacanth, 6; glycerin, 18; water to make 100. (U. S.)

Dose.—Ad. lib.

Action and Uses.—Tragacanth is a demulcent, but is chiefly used in the preparation of mixtures and emulsions to suspend oils, resins and insoluble powders.

Althæa. Althæa. (U. S. P.)

Synonym.—Marshmallow root, E.; racine de guimauve, Fr.; altheewurzel, eibischwurzel, G.; radix althææ, P. G.

The root of Althæa officinalis Linné (nat. ord. Malvaceæ).

Habitat.—N. and W. Asia and Europe. Cultivated in Europe,

and naturalized in E. United States and Australia, growing in salt marshes.

Constituents.—1, bassorin, 35 per cent.; 2, pectin, 10 per cent.; 3, asparagin, 1 per cent.; 4, sugar, 8 per cent.

Action and Uses.—Althæa is occasionally employed as a demulcent in irritable conditions of the digestive canal, and as a vehicle in the form of syrup.

Saccharum. Sugar. $C_{12}H_{22}O_{11}$. (U. S. P.)

Synonym.—Saccharum purificatum, B. P.; refined sugar, cane sugar, E.; sucre, sucre de canne, Fr.; zucker, rohrzucker, G.

The refined sugar obtained from Saccharum officinarum Linné, and from various species or varieties of sorghum (nat. ord. Gramineæ); also from one or more varieties of Beta vulgaris Linné (nat. ord. Chenopodiaceæ).

Habitat.—Indigenous in S. Asia, but cultivated in many tropical and sub-tropical countries.

Properties.—White, hard, dry, distinctly crystalline granules, odorless, and having a purely sweet taste. Permanent in the air. Soluble in 0.46 part of water; in 0.2 part of boiling water, and in 137.2 parts of alcohol. Insoluble in ether, chloroform, or carbon disulphide.

PREPARATION.

Syrupus. Syrup. (U. S. P.)

Synonym.—Simple syrup, E.; sirop de sucre, Fr.; weisser syrup, G.; syrupus simplex, P.G.

Made by solution of sugar, 850; with heat in distilled water, straining, and addition of distilled water to make 1000. (U. S. P.)

Molasses. (Non-official.)

Synonym.—Theriaca, B. P.; sacchari faex, syrupus fuscus, treacle, E.; mélasse, Fr.; melasse, G.

The brown, uncrystallizable syrup that drains away from the crystals of raw sugar in the refining process.

Action and Uses.—Sugar, syrup and molasses are demulcents, and are sometimes employed in medicated syrup or electuary, for their soothing action on the throat in catarrh of the upper air passages. They are liable to ferment in the alimentary canal if given continuously, with the production of acidity and indigestion, so that they are not suitable for general use as demulcents. Sugar, syrup and molasses are mainly useful as vehicles, corrigents, preservatives,

and excipients in pharmacy. Sugar is utilized as a constituent of powders, and syrup and molasses are excipients in the preparation of balls and electuaries. Sugar increases the solubility of calcium salts (see Syrupus Calcis, p. 148) and protects ferrous compounds from oxidation (see Ferri Carb. Sacch., p. 183).

Sugar is an antiseptic, and, in syrup, prevents the fermentation of active medicinal substances. Brown sugar and molasses are laxative, in large doses, and are prescribed in veterinary practice, with ginger, to aid the action of salts on cattle (Oss.-i) and sheep (℥ ii.-vi.). (See Epsom salts, p. 154.) Molasses and milk, equal parts, form an excellent enema for stimulating peristalsis, 4 to 6 ounces of each for dogs, and 2 quarts of each for horses or cows.

SECTION XIV.—VEGETABLE DRUGS KILLING PARASITES.

Class 1.—Used to Destroy Tape-Worms.

ASPIDIUM. Aspidium. (U. S. P.)

Synonym.—Filix mas, B. P.; radix filicis maris, male fern, male shield fern, E.; rhizome (racine) de fougère mâle, Fr.; wurmfarnwurzel, waldfarnwurzel, johanniswurzel, G.; rhizoma filicis, P. G.

The rhizome of Dryopteris Felix-mas Schott, and of Dryopteris Marginalis (Linné) Asa Gray (nat. ord. Filices).

Habitat.—D. filix-mas, Europe; D. marginalis, U. S.

Description.—Before being peeled, 10 to 15 Cm. long by 5 to 7 Cm. thick, including the densely imbricated, dark brown, cylindraceous, slightly curved stipe-bases and the dense mass of brownish, glossy, transparent, soft, chaffy scales; when peeled, 1 to 2 or 3 Cm. thick, cylindraceous and nearly straight, or curved and tapering towards one end, roughly scarred with remains of the stipe-bases, or bearing several coarse longitudinal ridges and grooves; pale green when first peeled becoming pale brown; fracture sharp, pale green, the texture rather spongy, exhibiting from 6 to 10 steles in a loose and interrupted circle; odor disagreeable; taste bitter-sweet, astringent, acrid, and nauseous.

The chaff, together with the dead portions of the rhizome and stipes, should be removed, and only such portions used as have re-

tained their internal green color. Powdered Aspidium should be freshly prepared and have a bright green color.

Constituents.—Aspidium contains: (1) filicic acid ($C_{35}H_{42}O_{13}$), a white, amorphous crystalline substance, and a series of bodies, as aspidin, aspidinin, flavaspadic acid, albaspidin, aspidol, filmaron and flavaspidinin. It is not known to which of the bodies the action of aspidium may be attributed. There are also: (2) a fixed oil, 6 per cent.; (3) resin, 4 per cent.; (4) filicin ($C_{35}H_{40}O_{12}$), a crystalline principle soluble in chloroform, benzol, fixed and volatile oils; (5) filix-red, a coloring matter; (6) a small quantity of a volatile oil.

Dose.—H. & C., ʒ v.-vi. (150.-180.); Sh., ʒ ii.-iv. (60.-120.); Lambs, ʒ i.-ii. (4.-8.); D. & C., ʒ ss.-i. (15.-30.).

PREPARATION.

Oleoresina Aspidii. Oleoresin of Aspidium. (U. S. P.)

Made by percolation with ether, distillation and evaporation of the ether. *Dose* (also of the extractum filicis liquidum, B.P.)—H. & C., ʒ iii.-vi. (12.-24.); Sh. & Sw., ʒ i.-ii. (4.-8.); D. & C., ♏xv.-ʒ i. (1-4.)

Action and Uses.—Aspidium is chiefly of value in veterinary medicine as a taeniacide or agent destroying tape-worms, particularly those inhabiting dogs. Large quantities of the drug cause hemorrhagic gastro-enteritis, tremors, weakness, stupor, coma, acute nephritis and cystitis. Six drachms of the oleoresin have proved fatal in man and sheep; five drachms in a medium-sized dog; and three ounces in the case of a cow. Aspidium must never be given with oil, which aids its absorption. Dogs should be fasted 24 hours or fed on a little milk; then the oleoresin should be administered, and the dose repeated in 3 hours. After the expiration of 12 hours from the administration of the first dose, a purgative quantity of castor oil is to be exhibited. An injection of salt and water assists the expulsion of segments of tænia from the rectum. If the head of the tænia is not expelled the treatment may be repeated in three days or a week. The oleoresin may be flavored with a few drops of oil of peppermint, and is often combined with a small dose of areca nut (gr. i. to the lb. live weight) in emulsion with mucilage of tragacanth, or with fluid extract of kousso, ʒ i. to ʒ ii. The oleoresin may also be exhibited in pills or capsules. It is on the whole the best agent against the tapeworms of dogs, including Tænia serrata, T. marginata, T. cœnurus and T. echinococcus. Oleo-resin of male fern has a decided action in destroying the flukes in the liver, gall bladder, and bile passages of sheep in distomiasis.

Four doses of 5 gms. each should be given 24 to 48 hours apart and, if liver cirrhosis has not set in, recovery may ensue.

Areca. (Non-official).

Synonym.—Areca-nut, betal-nut, E.; noix d'aréque, Fr.; arecanuss, G.

The seed of Areca Catechu (nat. ord. Palmaceæ).

Habitat.—India, Coromandel and Malabar coasts; also in warm parts of Asia.

Description.—The seeds resemble nutmeg in size, shape and color. They yield a brown powder, partially soluble in water and alcohol. The taste is astringent.

Constituents.—1, the active principle is the liquid alkaloid, arecoline ($C_8H_{13}NO_2$). Arecoline hydrobromide ($C_8H_{13}N\ O_2H\ Br$) is the commercial salt, occurring in colorless, anhydrous needle-shaped prisms, soluble in alcohol and water. H. & C., gr. ⅔-1½ (0.04-0.09); average dose, gr. i. (0.06) subcutaneously. There are three other alkaloids, arecaine, aracaidine and guvachine which are of no medicinal value. Red tannic acid. An oil.

Dose.—Areca nut—H., ʒ ss.-i. (15.-30.); Lamb, ʒ i. (4.); D., gr. ii. for each lb. of live weight, or gr. xv.-ʒ ii. (1.-8.); Fowl (against A. gibbosa), gr. x.-xl. in pill.

Action and Uses.—Areca nut is an anthelmintic more commonly classed as a tæniacide, but capable of killing round-worms satisfactorily. It acts more successfully as a vermicide in dogs than in the case of the larger animals. Areca nut is an astringent in small doses, but large amounts induce catharsis. When the drug is used as an anthelmintic the animal should be deprived of food for 24 hours previous to its administration. The powder is given to dogs in milk, frequently with oleoresin of male fern in small quantity. If purgation does not follow the use of areca nut within a short time, a dose of castor oil is indicated. The fluidextract is a more convenient preparation.

Arecoline has not been studied in scientific detail as to its physiological actions, but in general it resembles pilocarpine. It contracts the pupil. It stimulates the secretions of sweat, saliva, and succus entericus. It moreover stimulates peristaltic action, and is one of the quickly acting purgatives given under the skin. While sometimes causing considerable nausea and colic yet arecoline is not so powerful or poisonous as eserine and barium chloride and, as it can be given subcutaneously, is often preferred by practitioners to the aforesaid drugs. In large doses it diminishes the force and frequency of the pulse and in lethal doses paralyzes the heart. The

breathing is quickened by small doses but in fatal amounts the respiration fails and there is dyspnea and death from respiratory arrest. Large doses cause muscular spasms.

Arecoline is indicated in mild colics, indigestion, flatulent colic and impacted colon in horses. Also in acute laminitis and hemoglobinuria of horses. In severe impactions and great distention, obstruction and inflammation of the bowels, it is contraindicated. In constipation of cattle it is also of value. Its cathartic action usually begins within 15 minutes. One per cent. solutions of arecoline hydrobromide are sometimes used to contract the pupil and reduce intraocular tension.

Kamala. Kamala. (Non-official.)

Synonym.—Rottlera.

The glands and hairs from the capsules of Mallotus philippinensis (Lamarck) Mueller Arg. (nat. ord. Euphorbiaceæ).

Habitat.—India, China and the Philippine Islands.

Properties.—A granular, mobile, brick-red or brownish-red powder, inodorous, and nearly tasteless; imparting a deep red color to alkaline liquids, alcohol, ether or chloroform, and a pale yellow tinge to boiling water. Under the microscope it is seen to consist of stellately arranged, colorless hairs, mixed with depressed-globular glands, containing numerous red, club-shaped vesicles.

Constituents.—The chief principle is (1) rottlerin ($C_{22}H_{20}O_6$), occurring in yellow acicular crystals, soluble in hot alcohol, ether, benzol, and carbon disulphide. There are also (2) resins, 80 per cent.

Dose.—D., ʒ ss. ii. (2.-8.); H. & C., ʒ i. (30.).

Action and Uses.—Kamala is an anthelmintic. It is employed more frequently as a taeniacide, but will also kill ascarides and oxyurides. Large doses may give rise to nausea and vomiting in dogs and cats. Kamala is also a purgative, so that it is rarely necessary to employ one after its administration. It should be given in syrup to the fasting animal, and repeated in eight hours if the first dose is not operative by that time.

Cusso. Kousso. (U. S. & B. P.)

Synonym.—Brayera, kooso, kusso, E.; cousso, kousso, Fr.; kosso, cusso, kusso, G.; flores kosso, P. G.

The female inflorescence of Hagenia abyssinica (Bruce) Gmelin (nat. ord. Rodaceæ).

Habitat.—Abyssinia.

Description.—In bundles, rolls, or compressed clusters consisting of pannicles about 25 Cm. long, with a sheathing bract at the base of each branch; the two roundish bracts at the base of each flower, and the four or five obovate, outer sepals are of a reddish color, membranous and veiny; calyx top-shaped, hairy, enclosing two carpels or nutlets; odor slight, fragrant and tea-like; taste bitter, acrid and nauseous.

Constituents.—1, the active principle is kosin or koussin, a yellow, tasteless, crystalline glucoside, soluble in alcohol, chloroform, benzol and ether, but insoluble in water; dose—dogs, gr. x.-xl. (.6-2.6); 2, a volatile oil; 3, gum; 4, tannic acid; 5, two resins.

Dose.—Small dogs, ℥ ss.-i. (2.-4.); large dogs, ℥ ii.-iv. (8.-15.).

PREPARATION.

Fluidextractum Cusso. Fluidextract of Kousso. (Non-official.)

Synonym.—Extractum brayeræ fluidum.

Made by maceration and percolation of kousso with alcohol, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—Same as kousso.

Action and Uses.—Kousso is an effective taeniacide in dogs and cats. Large doses cause nausea, colicky pains and some catharsis. Kousso is administered in milk, or as an infusion flavored with peppermint; also in the form of the fluidextract, or glucoside in capsules, to the fasting animal. It should be repeated 3 times, at hour intervals, and followed by a small dose of castor oil if the bowels are not sufficiently relaxed. There is little danger of poisoning even by great quantities of the drug.

Granatum. Pomegranate.

Synonym.—Granati radicis cortex, B. P.; écorce de la racine de grenadier (de balaustier), Fr.; granat-wurzelrinde, G.; cortex radicis granati, P. G.

The bark of the stem and root of Punica Granatum Linné (nat. ord. Pumicaceæ).

Habitat.—India and S. W. Asia. Also cultivated and naturalized in sub-tropical countries.

Description.—Stem Bark.—In single quills or transversely curved pieces, mostly 2 to 10 Cm. long, 5 to 20 Mm. in diameter; bark 0.5 to 3 Mm. thick; outer surface yellowish- to brownish-gray, with brownish-black fruit-heads of a lichen and small lenticels; inner surface grayish-yellow to brownish, finely striate; fracture short,

smooth, the phelloderm layer dark green, the inner bark dull greenish-yellow; odor distinct; taste astringent, somewhat bitter.

Root Bark.—Dark brown, with more or less longitudinal patches and scales of cork; green phelloderm layer absent; medullary rays extending nearly to the periderm.

Constituents.—The active principle is (1) pelletierine ($C_8H_{13}NO$), ½ per cent., a colorless, oily, aromatic alkaloid, soluble in alcohol, chloroform and ether; four salts occur in commerce; the tannate, sulphate, hydrobromide and hydrochloride; the first is more frequently used; dose—D., gr. ii.-v. (.12-.3); 2, punico-tannic acid, 22 per cent.; 3, methyl, pseudo, and iso-pelletierine; the latter is a tæniacide.

Dose.—Dogs, 3 ss.-i.ss. (2.-6.)

PREPARATIONS.

Fluidextractum Granati. (U. S. P.)

Dose.—D., 3 ss.-i. (2.-4.).

Pelletierinæ Tannas. (U. S. P.)

Dose.—D., gr.iv. (.24).

Action and Uses.—Pomegranate is inferior to the foregoing drugs as an anthelmintic, since it is disagreeable and prone to produce vomiting. Pomegranate is an astringent, but, in large doses, acts as an emetic and purgative and has occasioned weakness, colic, dizziness and convulsions. In sufficient amount pelletierine is said to paralyze motor nerves, like curare. Granatum is an anthelmintic, chiefly against tape-worm. The decoction (1-8, B. P.) may be employed (with ¼ part syrup of ginger) in three doses, at hour intervals, for dogs. The patient should be previously fasted for 24 hours, and castor oil is indicated if purging is not produced by pomegranate. Tannate of pelletierine is a yellowish, astringent-tasting powder, soluble in 12.6 parts of alcohol and 235 parts of water. It is invariably used in human medicine in preference to the crude drug, and should be followed in 2 hours by a dose of castor oil. The use of pelletierine is undesirable in young animals.

Class 2.—Used to Destroy Round-Worms.

Santonica. Santonica. (U. S. & B. P.)

Synonym.—Levant worm seed, semen cinæ, s. contra, s. sanctum, s. santonici, E.; barbotine, semencine, Fr.; wurmsamen, zitwersamen, G.; flores cinæ, P. G.

The dried unexpanded flower-heads of Artemisia pauciflora Weber (nat. ord. Compositæ).

Habitat.—Northern middle Europe and Asia.

Description.—Heads 2 to 4 Mm. long, oblong-ovoid, slightly flattened, obtuse, consisting of an involucre of about 12 to 18 closely imbricated, glandular scales with broad midribs, enclosing 4 or 5 rudimentary florets. Santonica has the appearance of a granular, yellowish-green or greenish-brown, somewhat glossy powder; odor strong, peculiar, somewhat camphoraceous; taste aromatic and bitter.

Constituents.—The active principle is (1) santonin. There is also (2) a volatile oil, 2 per cent., consisting chiefly of cineol, $C_{10}H_{18}O$.

Santoninum. Santonin. $C_{15}H_{18}O_3$. (U. S. & B. P.)

Synonym.—Santonine, Fr.; santonin, G.

A neutral principle obtained from santonica.

Derivation.—Made from a mixture of lime and santonica by exhausting with alcohol, evaporation of the latter, and by the addition of acetic acid to the residue. Santonin is obtained by treating an alcoholic solution of the residue with animal charcoal and crystallization.

Properties.—Colorless, shining, flattened, rhombic prisms; odorless and nearly tasteless when first put in the mouth, but afterwards developing a bitter taste; not altered by exposure to air, but turning yellow on exposure to light. Nearly insoluble in cold water; soluble in 34 parts of alcohol, in 78 parts of ether, in 2.5 parts of chloroform, and in solutions of caustic alkalies.

PREPARATION.

Trochisci Santonini. (U. S. & B. P.)

U. S. P., gr.ss.; B. P., gr.i. each.

Dose.—Puppies, gr. ¼-½ (.015-.03); D., gr. i.-iii. (.06-.18); H., 3 ¼-iv. (1.-15.).

Action and Uses.—Santonin is preferable to santonica. Santonin is chiefly valuable as a parasiticide against round-worms; viz.: A. lumbricoides of cattle and swine, A. mystax and marginata of cats and dogs, and A. megalocephala of horses. It has no influence on tape-worms, nor probably on oxyurides.

Large doses cause poisoning, with the occurrence, in dogs, of nausea and vomiting, weakness, giddiness, muscular trembling, salivation, twitching of the head muscles, rolling of the eyes and grind-

ing of the teeth. Then flexion and extension, and rotation of the head from side to side, are followed by epileptiform convulsions. Between the convulsions momentary contractions of the muscles all over the body may be seen (Cushny). The convulsions are due to stimulation of the cerebral cortex and the parts lying between the cerebral peduncles and medulla. There are—slow pulse, dilated pupils, and rapid respiration, and death ensues from asphyxia. While 5 to 6 grains induce symptoms of poisoning in dogs, ½ to 1 drachm has often failed to produce a fatal result. Santonin is eliminated by the kidneys, increasing their secretion, coloring an acid urine yellow, and an alkaline urine purplish-red, or a bloody hue. Xanthopsy or yellow sight occurs in man, probably from a specific action on the retina. There is congestion of the heart, lungs and nervous centres observed after death, but no gastro-enteritis. Santonin is very slowly absorbed from the intestines and is oxidized in the tissues and eliminated as oxysantonins. The best treatment of poisoning consists in emptying the stomach and bowels by emetics and purgatives, and in the use of artificial respiration, cold to the head, inhalations of anesthetics, and enemata of chloral, to relieve the convulsions. The administration of santonin should be followed or accompanied by that of a cathartic, as santonin is repugnant, rather than fatal, to worms.

The drug may be given to fasting puppies as follows:

℞ Hydrarg. Chlorid. Mitis.
Santonini .....aa gr.v.
Sacchari .....ad. ʒ i.
M. et div. in chart. no. x.
Sig. One powder tid. (for round-worms).
℞

or:—

Santonini .....gr. vi.
Ol. Ricini .....ʒ ii.
M.
Sig. Give one-third every third day (for round-worms).

Santonin may be given in pill to dogs combined with oleoresina filicis and areca nut. Santonin is not so commonly or successfully used in the treatment of round-worms in horses, as turpentine and aloes, creolin, etc. A ball containing ʒ ii. of santonin and ʒ i. of calomel, or a combination of ʒ iv. santonin and 1 pint of castor oil, are suitable prescriptions for the horse. Santonin is often remedial in incontinence of urine in young animals, when belladonna fails, and is frequently beneficial in the treatment of amaurosis.

Class 3.—Used to Destroy Lice.

STAPHISAGRIA. Staphisagria.

Synonym.—Staphisagriæ semina, B. P.; stavesacre, semina staphidis agriæ s. pedicularis, E.; staphisaigre, Fr.; stephauskörner, lause körner, G.

The ripe seeds of Delphinium Staphisagria Linné (nat. ord. Ranunculaceæ).

Habitat.—Shores of Mediterranean; cultivated.

Description.—Irregularly tetrahedral, one side convex, 5 to 6 Mm. long and 3 to 6 Mm. broad; externally blackish-brown, becoming lighter with age, strongly reticulate; endosperm oily, enclosing a small, straight embryo; odor slight; taste intensely bitter and acrid.

Constituents.—1, the important principle is delphinine ($C_{22}H_{35}NO_6$), a white, poisonous, crystalline alkaloid resembling veratrine and aconite; soluble in alcohol, chloroform, and ether; 2, delphisine ($C_{27}H_{46}N_2O_4$); 3, delphinoidine ($C_{42}H_{68}N_2O_7$); 4, staphisagrine ($C_{22}H_{22}NO_5$); 5, a fixed oil.

Action and Uses.—Powdered staphisagria is employed solely to kill lice (pediculi) in ointment (1-2) with benzoinated lard or vaseline. Creolin solutions (3-6 per cent.), tobacco infusions (5-10 per cent.), and oil of anise with sweet oil (1-10 per cent.), are also used for the same purpose. The latter mixture is an elegant preparation for pet dogs.

The tincture of larkspur (Delphinium consolida), another species of the same genus, is also a very efficient parasiticide against pediculi. It contains 1 part of larkspur seeds to 16 of alcohol.

Class 4.—Used to Destroy Fleas.

PYRETHRUM. Pyrethrum. (Non-official.)

Synonym.—Persian, Caucasian or Dalmatian insect powder.

The root of *Anacyclus Pyrethrum* (Linné) De Candolle (Fam. *Compositæ*).

Habitat.—Caucasian Mountains; cultivated in California, U. S.

Description.—Somewhat fusiform, nearly simple, 5 to 10 Cm. long, 2 to 20 Mm. in diameter, externally dark brown or grayish brown, longitudinally wrinkled and somewhat furrowed, crown somewhat annulate and sometimes crested with coarse fibres or with soft wooly hairs, fracture short, bark dark brown, resinous, 5 to 6 Mm.

thick, closely adhering to the light yellow radiate porous wood; odor distinct, taste pungent, very acrid, producing a prompt sialagogue effect. Pyrethrum powder is the best parasiticide for fleas (pulicidæ). It is used more frequently to kill these parasites on cats and dogs. Pyrethrum is simply dusted over the whole body or is applied in the form of a tincture (1-4), diluted with 10 parts of water.

The application of Dalmatian insect powder to kittens and puppies, or to dogs and cats in enfeebled condition, may be attended with danger unless the powder is brushed off within 10 or 15 minutes after its use. Deaths have occurred in these animals following its free and careless employment.

SECTION XV.—VEGETABLE DRUGS STIMULATING UNSTRIATED MUSCLE, PARTICULARLY THAT OF THE UTERUS.

ERGOTA. Ergot. (U. S. & B. P.)

Synonym.—Ergot of rye, spurred rye, E.; ergot, ergot de seigle, ergot de blé, blé cornu, Fr.; mutterkorn, kornmutter, zapfenkorn, G.

The sclerotium of Claviceps purpurea (Fries) Tulasne (Fam. Hypocreaceæ), replacing the grain of rye, Secale cereale Linné (nat. ord. Gramineæ).

Habitat.—Ergot is obtained mainly from Spain and Russia.

Description.—Subcylindrical, obscurely three-angled, tapering toward both ends but obtuse, somewhat curved, 1.5 to 3 Cm. long and about 3 Mm. thick; externally purplish-black, longitudinally furrowed on each side, more conspicuously on the concave side; fracture short, pinkish or reddish-white; odor peculiar, heavy, increased by trituration with potassium hydroxide T. S.; taste disagreeable.

Constituents.—The active principles of ergot have hitherto been considered to be sphacelinic acid, sphacelotoxin, cornutine, and ergotinic acid but these were not pure and the recent researches of Barger and Dale have shown the true active principles to be the following alkaloids: (1) Ergotinine, $C_{35}H_{39}O_5N_5$, inert but easily converted into its hydrate (2) ergotoxine, $C_{35}H_{41}O_6N_5$, which is most active; (3) tyramine, $OH\text{-}C_6H_4\text{-}CH_2CH_2NH_2$, resembling adrenalin in chemistry and therapeutics, and (4) isoamylamine $(CH_3)_2CHCH_2CH_2NH_2$; (5) an inert oil; (6) saponin bodies. The two latter cause suspension of the active principles in alcohol and water.

Dose.—H. & C., ℥ ss.-i. (15.-30.); Sh. & S., ʒ i.-ii. (4.-8.); D., ʒ ss.-i. (2.-4.).

PREPARATIONS.

Fluidextractum Ergotæ. Fluidextract of Ergot. (U. S. P.)

Made by maceration and percolation with diluted alcohol and acetic acid, and evaporation, so that 1 cc. = 1 gm. of ergot.

Dose.—H. & C., ℥ss.-i. (15.-30.); Sh. & Sw., ʒ i.-ii. (4.-8.); D., ʒ ss.-i. (2.-4.).

Extractum Ergotæ. Extract of Ergot. (U. S. & B. P.)

Synonym.—Ergotin.

Made by evaporation of the fluidextract to a pilular consistence.

Dose.—H. & C., gr.xx.-ʒ i. (1.3-4.); D., gr.ii.-x. (.12-.6). (By mouth or subcutaneously.)

Extractum Ergotæ Liquidum. (B. P.)

(℥ i. ergot = ℥ i. of preparation.)

Dose.—Same as fluidextract.

Tinctura Ergotæ Ammoniata. (B. P.)

(109 gr. to ℥ i.)

Dose.—H. & C., ℥ ss.-ii. (15.-60.); Sh. & Sw., ʒ i.-iv. (4.-15.); D., ʒ ss.-ii. (2.-8.).

Injectio Ergotini Hypodermica. (B. P.) (33 per cent.)

Dose.—H., ʒ¾-1½ (3.-6.); D., ♏iii.-x. (.2-.6).

Ergot deteriorates rapidy with age. Both it and its preparations should be fresh and the drug should be discarded when over a year old.

Action Internal.—Digestive Organs.—Ergot (tyramine) stimulates the splanchic inhibitory fibres supplying the stomach and intestines so that the motion and tone of these are somewhat inhibited. While vomiting and purging follows toxic doses of ergot the precise physiological cause is unknown.

Circulation.—Ergot is absorbed into the blood, but does not influence that fluid. The essential action of ergot is caused by its two alkaloids, tyramine and ergotoxine. Its effect on the circulation resembles that of adrenalin but the action is less powerful and of much longer duration.

Constriction of the blood vessels of the belly and limbs with stimulation of the heart, constitutes the chief action on the circulation. This is brought about by the stimulating effect of ergotoxine on the vaso-constrictor nerve endings of the sympathetic nerves from the thoracic and lumbar spinal cord. There is great rise in blood

pressure, as always occurs when the vaso-constrictors of the splanchnic area are stimulated. Stimulation is followed by paralysis of the splanchnic vessels, after large doses.

The rate and force of the heart are augmented by stimulation of the heart muscle or accelerator nerve endings (tyramine). This is followed by slowing of the heart caused by stimulation of the vagus centre by the increased blood pressure. So after large doses there is depression of the accelerator nerve endings in the heart (ergotoxine). Ergot produces some constriction of the blood vessels when locally applied but not nearly to the extent observed with adrenalin, and for this reason it can be given by the mouth and subcutaneously, whereas the constriction induced by adrenalin is so great that its absorption is prevented and its systemic action is only shown when it is given intravenously.

Nervous System.—The nervous system is not affected by medicinal doses of ergot, nor by large single doses of the drug. Certain changes occur in poisoning, but these are not understood.

Uterus.—The most important action of ergot is that on the womb. It stimulates rhythmical uterine contractions by the paramount effect of ergotoxine in exciting the hypogastric motor nerve endings in the uterus. Tyramine on the other hand stimulates the inhibitory fibres of the hypogastric nerve and while its action is commonly overcome by ergotoxine yet in the non-pregnant cat it may lead to relaxation of the womb, when given alone, because the inhibitory nerves predominate. Contractions ordinarily alternate with relaxation of the womb under the influence of ergot, but after large doses the contraction may last many minutes. Ergot acts most powerfully on the pregnant uterus and often causes abortion. On the non-pregnant uterus it has less effect but is clinically of value in improving the tone and arresting hemorrhage from the non-pregnant womb, as well as following parturition. Ergot is *the* oxytocic in most common use.

Administration.—The fluidextract is generally given by the mouth. Some proprietary preparations are made for subcutaneous use. Bonjean's ergotin, or the official extract, are employed hypodermatically.

℞ Extr. Ergotæ .....gr.xl.
Alcohol.
Glycerini.
Aq. dest .....āā 3 i.
M.
Sig. Give one-half subcutaneously to a horse; 10 to 15 M. to dogs.

Injections should be made deeply into the muscular tissue to avoid abscess. Ergot should be repeated frequently to arrest hemorrhage.

Toxicology.—Enormous single doses are required to poison animals or man. When as much as two drachms of ergot to the pound, live weight, are given to dogs, death is not constant. Three ounces, however, have proved fatal to small dogs. *Acute poisoning* is characterized by vomiting (in dogs), diarrhea, profuse salivation, dilation of the pupils, rapid breathing, and feeble, frequent pulse. The animal cries out, has convulsive twitchings, staggering gait, paraplegia, intense thirst, icterus, coma, and death takes place by respiratory failure. Abortion may occur in pregnant animals. Horses, cattle, and sheep are unaffected by any ordinary quantity of the drug.

Chronic poisoning or ergotism rarely occurs in animals owing to continuous ingestion of ergotized grains. It is characterized by gastro-intestinal indigestion, with nausea, vomiting, colic, diarrhea or constipation, and abortion often ensues in pregnant animals. In addition to gastro-intestinal irritation the symptoms naturally assume two forms: 1, the gangrenous form; 2, the spasmodic form. In the first variety of ergotism there are coldness and anesthesia of the extremities, including the feet, ears, and tail of quadrupeds; the comb, tongue and beak of birds,—followed by the appearance of passive congestion, blebs, and dry gangrene in the vicinity of these parts. The hoofs and beaks often drop off. Death ensues from general exhaustion. In the spasmodic form are seen tonic contraction of the flexor tendons of the limbs and anesthesia of the extremities; muscular trembling and general tetanic spasm, with opisthotonos, convulsions and delirium. Death also occurs from asthenia. The cock is often used to test the activity of ergot. Sometimes the blood pressure is used as a guide. When a cock is given large doses it becomes drowsy, breathes with difficulty, sways in standing, loses appetite and often has vomiting and diarrhea with anorexia. The comb and wattles become of a dusky purple. With larger doses the comb becomes gangrenous, dries and falls, and there may be gangrene of the legs, tongue and wing, but recovery may ensue if the drug is withheld.

Uses.—Two therapeutic indications for the use of ergot can be directly deduced from its physiological actions: 1, to cause uterine contraction; 2, to produce vascular contraction.

1. Ergot is occasionally of service in simple uterine inertia when there is no malposition of the fetus, or mechanical obstruction (pelvic deformity, rigid os uteri) to its passage. Very small doses must be given for this purpose in order to intensify the force of the

uterine contractions without inducing spasm of the uterus. The more common causes of dystocia are remedied most advantageously by manual interference. Ergot is of chiefest value in obstetric practice to prevent or arrest post-partum hemorrhage which sometimes occurs in cows and ewes. If administered before delivery of the placenta, ergot may give rise to tonic contraction of the womb and retention of the afterbirth.

Ergot is of benefit in some disorders of the unimpregnated and non-parturient uterus. Thus to aid the expulsion of cysts, and to contract the uterus and its blood vessels in hypertrophy, subinvolution, chronic metritis and fibroid tumors.

In paralysis of the bladder, ergot is occasionally useful by creating contraction of the muscular coat of its walls. This condition is most satisfactorily treated by the injection of an ordinary dose of ergotin into the empty urinary bladder.

2. Ergot is commonly recommended for combating internal hemorrhage, when surgical measures are impossible. Under this head may be included bleeding from the nose, mouth, stomach, intestines, lungs, uterus and kidneys. Ergot has been thought beneficial in causing constriction of the blood vessels in the early stages of some hyperemias and inflammations, notably pulmonary, cerebral and spinal congestion, parturient apoplexy, cerebritis, cerebrospinal meningitis, spinal meningitis and myelitis.

There are two physiological reasons for the uselessness of ergot in preventing internal hemorrhages and congestions in special organs. (a) The fact that general blood pressure is so much augmented would favor hemorrhage from a ruptured vessel. (b) The fact that the blood vessels of the brain and lungs are not supplied by the vasomotor system and so there are no vaso-constrictors here to be stimulated by ergot. The effect of the drug on these organs would therefore be to cause vascular dilatation from increase of general blood tension. It is only in uterine hemorrhage that ergot proves of much value owing to the contraction of that organ. Ergot is recommended in surgical shock but adrenalin, morphine, digitalone, camphor and strychnine are more valuable. In dysentery, watery diarrhea, diabetes insipidus and bleeding piles ergot is said to be of service but we believe it of doubtful utility.

Gossypii Cortex. Cotton Root Bark. (U. S. P.)

Synonym.—Ecorce de racine de cottonnier, Fr.; baumwollenwurzelrinde, G.

The dried bark of the root of Gossypium herbaceum Linné, and of other species of Gossypium (nat. ord. Malvaceæ).

Habitat.—Sub-tropical Africa and Asia; also cultivated in the United States.

Description.—In thin, flexible bands or quilled pieces, the bark 0.2 to 1 Mm. thick; outer surface yellowish-brown, longitudinally wrinkled, with small lenticels, the periderm frequently exfoliated and somewhat fuzzy from partly detached bast fibres; inner surface whitish, longitudinally striate; fracture tough, fibrous, the bast-layer separable into thin laminæ; odor faint; taste slightly astringent and acrid.

Constituents.—1, a fixed oil; 2, a resin; 3, tannic acid.

PREPARATION.

Fluidextractum Gossypii Radicis. Fluidextract of Cotton Root Bark. (Non-official.)

Made by maceration and percolation with glycerin and alcohol, and evaporation, so that 1 Cc. = 1 Gm. of the crude drug.

Dose.—H. & C., ʒ ss.-i. (15.-30.); Sh. & Sw., 3 ss.-i. (2.-4.).

Action and Uses.—Cotton root bark resembles ergot in its actions and uses, but the drug has not been scientifically studied in full detail. It is an oxytoxic, abortifacient, and emmenagogue.

Cotton root bark is employed during parturition in uterine inertia, to prevent post-partum hemorrhage, to induce abortion, and to arrest metrorrhagia. A decoction (ʒ iv. to qt. boiled down to Oi.) is said to be more active than the fluid extract. *Dose.*—H. & C., Oi. (500.); D., ʒ i.-ii. (30.-60.).

Ergot is generally to be preferred as a more thoroughly understood and reliable drug.

SECTION XVI.—COLCHICUM.

Colchici Cormus. Colchicum Corm. (U. S. & B. P.)

Synonym.—Meadow saffron root, colchicum corm, bulbus seu tuber colchici, E.; bulbe de colchique, de safran bâtard, Fr.; zeitlosenknollen, G.

The dried corm of *Colchicum autumnale* Linné (Fam. *Liliaceæ*), yielding, when assayed, not less than 0.35 per cent. of colchicine.

Habitat.—England and continental Europe.

Description.—Ovoid, somewhat compressed laterally, and with a groove on one side, or more commonly in transverse, reniform, or longitudinal, ovate slices; externally brownish and finely wrinkled; internally whitish, with numerous circular groups of fibrovascular bundles, giving the surfaces of the transverse sections a papillose appearance; fracture short, mealy; odor slight; taste sweetish, bitter, and somewhat acrid.

Constituents.—1, the alkaloid colchicine ($C_{22}H_{25}NO_6$), is the active principle; it exists to the extent of 0.5 per cent.; is amorphous or crystalline, and soluble in water and alcohol; 2, colchiceine ($C_{21}H_{23}NO_6$), occurs naturally and is produced artificially by the action of acids on colchicine; slightly soluble in water, soluble in alcohol; 3, sugar; 4, starch; 5, gum.

Incompatibles.—Astringents, tincture of guaiacum and iodine.

Dose.—H. & C., 3 ss.-ii. (2.-8.); Sh., gr. x.-xx. (.6-1.3); Sw. & D., gr. ii.-viii. (.12-.5) in powder.

Dose.—Colchicina, Colchicine (U. S. P.)—H. & C., gr. ⅙-½ (.01-.03); D., gr. $\frac{1}{120}$-$\frac{1}{50}$ (.0005-.0012), by mouth or subcutaneously.

PREPARATIONS.

Vinum Colchici Radicis. Wine of Colchicum Root. (Non-official.)

Made by percolation of colchicum root (400), with alcohol (150), and white wine to make 1000.

Dose.—Twice that of colchicum corm.

Vinum Colchici. (B. P.)

Dose.—Twice that of the root.

Colchici Semen. Colchicum Seed. (U. S. P.)

Synonym.—Colchici semina, B. P.; semences de colchique, Fr.; zeitlosensamen, G.; semen colchici, P. G.

The seed of Colchicum autumnale Linné (nat. ord. Liliaceæ), yielding not less than 0.55 per cent. of colchicine.

Description.—Subglobular, about 2 Mm. thick, very slightly pointed at the hilum; reddish-brown, finely pitted, internally whitish; very hard and tough; inodorous; taste bitter and somewhat acrid.

Constituents.—1, colchicine, 3 per cent.; 2, colchiceine; 3, a fixed oil, 6-8 per cent.; 4, starch; 5, sugar; 6, gum.

Dose.—Same as corm, or a little larger.

PREPARATIONS.

Fluidextractum Colchici Seminis. Fluidextract of Colchicum Seed. (U. S. P.)

Made by maceration and percolation with alcohol and water, and evaporation, so that 100 Cc. will contain 0.5 Gm. of Colchicine.

Dose.—H. & C., ʒ ss.-ii. (2.-8.); Sh., ♏x.-xx. (.6-1.3); Sw. & D., ♏ii.-viii. (.12-.5).

Vinum Colchici Seminis. Wine of Colchicum Seed. (U. S. P.)

Made by maceration of colchicum seed, 100; alcohol, 150; and white wine to make 1000.

Dose.—H. & C., ʒ iii.-ʒ i. (12.-30.); D., ♏x.-xxx. (.6-2.).

Tinctura Colchici Seminis. Tincture of Colchicum Seed. (U. S. & B. P.)

Made by maceration and percolation of colchicum seed, 100; with alcohol and water to make 1000. (U. S. P.)

Dose.—H. & C., ʒ iii.-ʒ i. (12.-30.); D., ♏x.-xxx. (.6-2.).

Action External.—Colchicum is an irritant to the skin and mucous membranes.

Action Internal.—Digestive Organs.—Colchicum and colchicine are identical in action without regard to their method of introduction into the system. Colchicum is essentially a gastro-intestinal irritant in large doses. This irritant action may explain all its effects on other organs. Full medicinal doses occasion anorexia, nausea, colicky pains, loud intestinal rumblings (borborygmi), and purging. Colchiceine appears to closely resemble colchicine physiologically. Neither the circulation, nervous system, respiration, nor temperature are affected by colchicum save in poisonous doses.

Circulation.—Toxic doses reflexly influence the circulation, but colchicum does not appear to affect it directly until late in poisoning, when the vagus endings become depressed and paralyzed and the pulse is weak and rapid.

Nervous System.—Toxic quantities depress and paralyze the motor cells of the inferior cornua in the spinal cord, and also depress the sensory nerves. Death occurs from paralysis of the respiratory centres.

Kidneys and Elimination.—It is doubtful whether colchicum exerts any decided or uniform action on the kidneys. Experiments relating to this matter are perplexingly conflicting. Sometimes the urinary solids are increased—urea more than uric acid—and sometimes not. In poisoning, nephritis and hematuria occasionally result from the elimination of colchicum.

Toxicology.—Colchicum is a very poisonous drug. Accidental lethal poisoning occasionally occurs among herbivora from eating meadow saffron at pasture, or in hay. In such cases it is naturally impossible to estimate the quantity of the plant ingested. Two and one-half drachms of the wine of the root, and one-half grain of the alkaloid, have proved fatal to man. Two drachms of the corm have killed a dog, and one-tenth of a grain of colchicine has destroyed a cat. The symptoms of poisoning occur only after some hours when elimination begins and comprise: anorexia, nausea, dulness, salivation, violent vomiting (in carnivora), purging, at first watery, then mucous and often bloody, and accompanied by great tenesmus, tympanites, and colic, owing to elimination by the alimentary canal, as well as by the kidneys. There are often such nervous symptoms as tremors, stupor, coma, and paralysis beginning in the hind limbs and progressing to involve the fore limbs and respiratory muscles. Death occurs from respiratory failure as the breathing ceases before the heart beat. The effect on the nervous system is due to general collapse. The animal becomes very weak, its movements slow and difficult, the respiration is infrequent and feeble, the pulse rapid and imperceptible, the skin is cold and covered with a clammy sweat, and death occurs in collapse following severe gastro-enteritis. After the injection of large doses of colchicine, increasing the amount does not aggravate the symptoms.

Post-Mortem Appearances.—The mucous membrane of the stomach and intestines is swollen, congested, and eroded. Sometimes free blood is found within their lumen. There is also acute hyperemia of the kidneys.

Treatment.—This consists in the use of the stomach tube, emetics, and cathartics, unless there has been free purging and vomiting. Tannic acid is the best chemical antidote, but is not wholly satisfactory. It should be used, however. Demulcents (oil and egg albumin) and opium relieve the local irritation, pain and purging. Stimulants, as camphor, digitalone, atropine, strychnine, and alcohol, together with external heat, combat collapse.

Summary.—Medicinal doses produce no physiological effect. Large amounts cause renal and gastro-intestinal irritation and inflammation during the elimination of the drug.

Administration.—The crude drug is not suitable for use. The wine of the root is the best preparation.

Uses.—It is difficult to estimate the therapeutic value of colchicum. It is called an alterative by many authorities, for want of a better term to describe a drug whose physiological actions do not explain its medicinal virtues. Colchicum is the most successful single remedy for gout in human medicine, but does not possess

much value in veterinary practice. It is sometimes used with considerable advantage in the treatment of subacute and chronic rheumatism, and in that form complicating influenza in horses.

Potassium iodide is generally prescribed with colchicum in these disorders, and also in pericarditis and pleurisy of rheumatic origin. Colchicum is commonly believed to be a serviceable diuretic in various diseases (although this hypothesis is not physiologically substantiated). It is therefore recommended in hemoglobinuria and swelling of the legs in horses; in cerebral congestion; ascites; pleural and pericardial effusions, and dropsies, as an eliminative. Colchicine, subcutaneously, is especially lauded in rheumatism.

SECTION XVII.—VEGETABLE DRUGS ACTING MECHANICALLY.

Amylum. Starch. $C_6H_{10}O_5$. (U. S. & B. P.)

Synonym.—Corn starch, E.; fecule (amidon) de froment, de blé, Fr.; kraftmehl, weizenstärke, G.

The starch grains obtained from the fruit of Zea Mays Linné (nat. ord. Gramineæ).

Habitat.—Tropical Asia and Africa, but cultivated in tropical, sub-tropical and temperate countries.

Description.—In fine powder or irregular, angular white masses, consisting of somewhat spherical, but usually polygonal grains, about 0.010 to 0.025 Mm. in diameter, with a lenticular, circular, or triangular central fissure; inodorous and tasteless; insoluble in cold water or alcohol; forming a whitish jelly when boiled with water, which when cool gives a deep blue color with iodine T. S.; triturated.

Constituents.—1, starch-granulose; 2, starch-cellulose.

PREPARATION.

Glyceritum Amyli. (U. S. P.) (See p. 541.)

Glycerinum Amyli. (B. P.)

Action and Uses.—Starch is a mechanical protective externally, used as a dusting powder, alone or with zinc oxide (1-4), in chafing, erythema, and moist eczema. The glycerite of starch is a serviceable demulcent. Boiled starch paste, mixed with glue, is used to stiffen bandages by painting the mixture on in layers with a brush. Boiled

starch gruel (2 tablespoons of starch to a pint of water) is a suitable diet for diarrhea, and is frequently injected into the rectum as a demulcent in diarrhea and dysentery, and as a vehicle for enemata. Starch is an antidote to iodine. It is utilized in pharmacy as a vehicle to suspend insoluble powders or oils, and in mucilage (1-40, B. P.), as a basis for ointments. Zinc oxide, one part; starch and vaseline, each 3 parts, form a very satisfactory preparation for acute eczema in dogs, which does not rub off so readily as zinc ointment.

Oleum Theobromatis. Oil of Theobroma. (U. S. & B. P.)

Synonym.—Butter of cacao, E.; beurre de cacao, Fr.; cacaobutter, G.; oleum (butyrum) cacao, P. G.

A fixed oil expressed from the roasted seed of Theobroma Cacao Linné (nat. ord. Sterculiaceæ).

Properties.—A yellowish-white solid, having a faint, agreeable odor, and a bland, chocolate-like taste. Readily soluble in ether or chloroform.

Constituents.—1, olein; 2, stearin; 3, theobromine, $C_7H_8N_4O_2$, an alkaloid; 4, glycerides of formic, butyric, and acetic acids.

Uses.—Cacao butter melts at the temperature of the body, and is chiefly used as an excipient for suppositories and electuaries. It also has a demulcent action and may be employed on raw surfaces or in inflammation of the throat and digestive tract.

Gossypium Purificatum. Purified Cotton. (U. S. P.)

Synonym.—Absorbent cotton, E.; bombyx, lana gossypii,—coton, Fr.; baumwolle, G.

The hairs of the seed of Gossypium herbaceum Linné, and of other cultivated species of Gossypium (nat. ord. Malvaceæ), freed from adhering impurities and deprived of fatty matter.

Habitat.—Tropical Asia and Africa; cultivated in subtropical and tropical countries, mostly in the Southern United States.

Description.—White, soft, fine filaments, appearing under the microscope as hollow, flattened and twisted bands, spirally striate and slightly thickened at the edges; inodorous and tasteless; insoluble in ordinary solvents, but soluble in copper ammonium sulphate solution.

Uses.—Absorbent cotton is used as a cheap, convenient and cleanly substitute for ordinary sponges; to make poultices by soaking it in antiseptic solutions (as lysol or creolin, 1-2 per cent.) and placing it between layers of gauze; and for surgical dressings.

Oakum, consisting of the fibres of old rope, is often employed as a cheap absorbent material, saturated with tar, in packing horses' feet.

Tow,—The coarser unbleached fibres of flax; and lint,—the scrapings of soft, loosely woven linen,—are also utilized as absorbent substances for surgical purposes.

Pyroxylinum. Pyroxylin. (U. S. & B. P.)

Synonym.—Gun cotton, soluble gun cotton, colloxylin.

Derivation.—Made by maceration of purified cotton, 100; in a mixture of nitric acid, 1400; and sulphuric acid, 2200; at a temperature of 32° C. (90° F.), until a sample is soluble in a mixture of 1 volume of alcohol and 3 volumes of ether; washing with cold and boiling water, draining, and drying in small pellets.

PREPARATIONS.

Collodium. Collodion. (U. S. & B. P.)

Pyroxylin, 40; ether, 750; alcohol, 250. Made by solution, agitation, and decantation of clear portion.

Collodium Cantharidatum. Cantharidal Collodion. (U. S. P.)

Synonym.—Blistering collodion.

Made by percolation of cantharides, 60; with chloroform, distillation of the chloroform and evaporation of the residue until it weighs 15 (Gm.), and solution in flexible collodion, 85.

Collodium Flexile. Flexible Collodion. (U. S. & B. P.)

Mix collodion, 920; Canada turpentine, 50; and castor oil, 30. (U. S. P.)

Collodium Stypticum. Styptic Collodion. (U. S. P.)

Mix tannic acid, 20; alcohol, 5; ether, 25; add collodion to make 100.

Action and Uses.—Collodion, when painted on dry skin, rapidly dries and leaves a thin, protective coating. It is a useful agent to seal and secure coaptation of small wounds and to keep them aseptic. Also to protect abraded surfaces, as fissures of teats. Flexible collodion is less apt to crack. Collodion contracts the superficial tissues and will often abort boils when applied directly over them. Collodion is employed as a vehicle for the application of many other agents, as salicylic acid (p. 444), corrosive sublimate, carbolic acid, iodoform, etc.

EUPHORBIUM. Euphorbium. (Non-official.)

The dried juice of a cactus-like plant, Euphorbium resinifera, growing in Morocco and regions contiguous to the Atlas Mountains. Obtained by incising the stems and branches.

Description.—In dull yellowish tears, of the size of peas; odorless; taste acrid; powder of a grayish color; insoluble in water, but soluble in alcohol, ether and oil of turpentine.

Constituents.—1, an amorphous, bitter, acrid resin ($C_{10}H_{16}O_2$), 40 per cent., the active principle; 2, euphorbon ($C_{13}H_{22}O$), a crystalline resin, soluble in chloroform and ether (20 per cent. of drug).

Action and Uses.—Euphorbium is an intense irritant, both externally and internally. It is sometimes employed in veterinary medicine as a constituent of vesicating preparations to enhance their effect, but if applied alone it is liable to cause extensive irritation, sloughing, and destruction of tissue. Euphorbium may, however, be safely applied in tincture (1-16), or in ointment with cantharides, as a vesicant for horses. The following combination is recommended as a powerful blister for the latter animals. Euphorbium and cantharides, each two parts; corrosive sublimate, one part; vaseline, eight parts; cerate, twelve parts. There is no danger of absorption and genito-urinary inflammation from the use of euphorbium, as with cantharides.

SECTION XVIII.—MEDICINAL AGENTS OF ANIMAL ORIGIN.

GLANDULÆ SUPERENALES SICCÆ. Dessicated Suprarenal Glands. (U. S. P.)

The suprarenal glands of the sheep (*Ovis aries* Linné) or ox (*Bostaurus* Linné), freed from fat, and cleaned, dried, and powdered.

A light yellowish-brown, amorphous powder, having a slight, characteristic odor; partially soluble in water.

Dose.—H., 3 i. (4.); D., gr. iv. (.25).

ADRENALIN or EPINEPHRIN, $C_6H_3(OH)_2\ CHOH\ CH_2\ NHCH_3$.

Adrenalin (epinephrin) is the active principle of the suprarenal glands, first isolated by Abel (although the discovery is commonly

credited to Takamine), and introduced into medicine at the beginning of this century. It is a light, white, microcrystalline substance, slightly soluble in cold water, especially when slightly acidulated with HCl. It has a somewhat bitter taste and produces a benumbing of the tongue. Adrenalin is permanent in powder, but changes color and is oxidized in aqueous solution. It is said to be *the* active principle of the suprarenals, but non-toxic, which can not be said of the glands or their extracts (and not of adrenalin). Adrenalin is from 825 to 1,000 times more powerful than the glands in its physiological effect. Solutions may be boiled without impairing their therapeutic activity.

Action.—Circulation.—The action of adrenalin on the circulation is only seen to advantage when the drug is given intravenously. Then there is a great rise of blood pressure and the heart beats first more rapidly and strongly, then more slowly, and again it is accelerated. The cause of the high blood pressure is stimulation of the sympathetic nerve endings (vasoconstrictors) of the thoracico-lumbar cord, and also it is in part due to the stronger contractions and more complete evacuation of the heart cavities, thus increasing its output. The vessels in the abdominal cavity are more particularly contracted while the blood vessels of the lungs, brain and heart are not supplied with sympathetic fibres and are not constricted. The result is that the blood is forced out of the abdominal organs, and the heart, lungs and brain are correspondingly congested.

The peculiar effect of adrenalin on the heart is due to primary stimulation of the accelerator nerve endings of the heart muscle, making the organ beat faster and more strongly, while the slowing is due to stimulation of the vagus centre by the increased blood pressure. Acceleration again occurs when the blood pressure falls away, and the vagus ceases to be stimulated, and accelerator stimulation resumes its sway. The action on the circulation is very transient, lasting not more than ten minutes, and being repeated with each new dose.

But the predominant and most valuable effect of adrenalin consists in the complete blanching of mucous membranes and raw surfaces after the local application of these substances. Adrenalin is undoubtedly the most powerful astringent and hemostatic known, owing to its stimulation of the involuntary muscles of the blood vessels.

Subcutaneous injection of a 1 to 1000 solution causes blanching over an area about two inches in diameter within a minute and lasts for six to twelve hours. Solutions containing adrenalin to the amount of 1 to 5000, 1 to 10,000, or even 1 to 20,000, will produce an ischemia after their hypodermic use within a few minutes and

lasting for three to six hours. Neither ecchymoses nor sloughing occurs after the proper injection of the drug. Secondary hemorrhage does not ordinarily appear after the use of adrenalin, but it will prevent the secondary relaxation, congestion and pain sometimes seen following the use of cocaine.

The local constricting action is undoubtedly due to direct stimulation of the vasoconstrictor nerve endings as it does not occur when adrenalin is painted on the lung or brain since their vessels are not supplied with sympathetic fibres.

The local contraction of blood vessels by adrenalin prevents its ready absorption when it is applied externally, taken by the mouth or injected subcutaneously. For this reason the intramuscular, or better, intravenous injection are indicated for its systemic effect.

Abdominal Organs.—Here stimulation of the sympathetic nerve endings gives rise to different actions according to the special functions of the fibres stimulated. Thus movements of the bowels and stomach are inhibited, and lost in poisoning, through stimulation of the splanchnics. The same action is exerted on the gall bladder whose movements are inhibited. The pyloric, anal and ileo-colic sphincters, on the other hand, receive motor fibres from the sympathetic and are thus contracted by the stimulation of the sympathetic. Action on the uterus (contraction or relaxation from preponderance of inhibitory or motor fibres) varies with the species of animal and whether pregnant or non-pregnant, according to the particular effect of the sympathetic stimulation. The same remark applies to the action of adrenalin on the urinary bladder.

Toxicology.—Poisoning may be produced in animals by the intravenous and subcutaneous injection of adrenalin. In smaller poisonous doses there are glycosuria, diuresis and nephritis, while fatal amounts cause vomiting, restlessness, tremors, paraplegia, prostration, dyspnea from edema of the lungs, respiratory failure and death. There is increase in the secretion of saliva, tears, bile and esophageal and bronchial mucus. The secretions are increased by sympathetic stimulation but not greatly, on account of the vascular constriction.

Summary.—Study of the evolutionary development of the suprarenals shows that the secreting portion of the glands is derived from the sympathetic system. Suprarenal secretion (adrenalin) acts in the body to always and everywhere stimulate sympathetic nerve endings.

Thus it stimulates the heart (accelerator stimulation), constricts blood vessels (vasoconstrictor stimulation), inhibits the action of the stomach and bowels (splanchnic stimulation), dilates the pupil (sympathetic nerve stimulation), and contracts or relaxes the uterus

according as to whether the motor or inhibitory fibres predominate in the hypogastic nerve.

Many authors teach that adrenalin acts by direct stimulation of unstriated muscle. But it affects unstriated muscle differently (relaxation or contraction) and its action corresponds precisely to sympathetic stimulation. Furthermore it fails to constrict the vessels of parts (lungs and brain) not supplied by sympathetic fibres.

Uses.—External.—Adrenalin chloride is commonly sold in a 1 to 1000 aqueous solution in the shops. It has proven of most value when combined with cocaine for subcutaneous use in operative work. One part of the 1-1000 solution may be added to nine parts of normal salt solution (one heaping teaspoonful of sodium chloride to the quart of sterile water), to which is added 1 per cent. of cocaine, or more if desired. A stronger solution of adrenalin chloride than this (1 to 10,000) is not usually desirable in operative work, because it is irritating, and in some instances when stronger solutions were used so much ischemia was produced that the blood vessels could not be found and ligated and secondary hemorrhage ensued. It is usually sufficient to add ♏x.-xx. adrenalin solution (1-1000) to ℥ss. of cocaine solution.

The combination of cocaine with adrenalin is coming into general favor and marks a distinct progress in local anæsthesia. Four advantages are claimed for this combination; 1, that the operation is made comparatively bloodless; 2, that the cocaine is retained in the operative field a longer time, owing to the contracted state of the vessels, and does not escape into the general circulation; this is a double advantage—in prolonging anæsthesia and in preventing systemic effect of cocaine; 3, that adrenalin is a circulatory stimulant and will offset the toxic action of cocaine; 4, that adrenalin counteracts the vascular relaxation seen sometimes after the use of cocaine.

Adrenalin has also proven of great service in arresting hemorrhages from wounds, mucous membranes and cavities of the body. A solution equivalent to a 1 to 5000 of adrenalin in sterile salt solution may be applied for this purpose directly to the bleeding surface, or gauze saturated with it may be packed into wounds and cavities, as the nose, uterus and vagina. Adrenalin chloride is useful also in many inflammatory diseases of the eye and nose in the same strength. Catarrhal conjunctivitis, keratitis, episcleritis and iritis yield to its influence, particularly when it is combined with other astringents on account of its transient action. It is instilled with atropine in iritis. Adrenalin chloride in a 1 to 5,000 solution containing 2 per cent. of boric acid forms a useful preparation for general applications in inflammations of mucous membranes. Two to four Cc. of adrenalin solution are injected on either side of the fetlock in acute laminitis

to lessen the blood supply in the foot. The treatment is too recent to determine its value and the reports have been somewhat conflicting.

Internal.—Adrenalin has been given empirically in azoturia with the most favorable results according to the reports of many reliable practitioners. Two drams of the 1-1000 solution in a little water are to be administered every two hours, combined with arecoline under the skin. Adrenalin is employed internally to arrest bleeding from the stomach, intestines and uterus. Its local application in hemorrhage from the bladder, rectum, nose, vagina and uterus is, however, much more effective. The drug is said to have yielded good results in human practice in the treatment of diabetes insipidus and purpura hemorrhagica. It is not of benefit for the arrest of internal hemorrhage other than in the digestive tract. This follows because it does not contract the vessels of the brain and lungs and because its effect in increasing general blood tension is inimical to its local effects in constricting vessels. Reichert, as the result of his experiments on morphinized dogs, believes that adrenalin is a valuable and rapidly acting stimulant to the heart, vasomotor system and respiration in poisoning by opium and anesthetics.

The latest experimental and clinical studies show adrenalin is of chief value for internal use in conditions of greatly reduced blood pressure, as in poisoning by ether and chloroform inhalation, by chloral, and in surgical shock. Here it is now considered the most efficient remedy, although its action is very transient. Bossi has artificially produced osteomalacia in sheep by removal of one adrenal gland. Treatment has likewise been successful in osteomalacia in the human, and in rickets in puppies by intramuscular injection of 1-1,000 adrenalin solution (m.v.-xv. t.i.d.).

Administration.—Adrenalin is preferable to the so-called suprarenal extracts, the dried and powdered suprarenal capsules of sheep and oxen. When the drug is given by the mouth or rectum, its action on the system at large is slow and uncertain, owing to the tardiness of absorption, presumably due to the vascular constriction it occasions and to its rapid decomposition. Intravenous injection is most effective in solutions of 1 to 10,000, or more dilute, in normal salt solution. Subcutaneous injection is somewhat uncertain owing to slow absorption, through vascular constriction. But the 1-1,000 solution (H., ʒ i.; D., ♏x.) may be injected deep into the muscle with certain effect and without irritation. A stronger solution than 1 to 10,000 may cause an abscess if the drug be given hypodermically. The doses of adrenalin chloride in 1 to 1000 solution are: Dogs, ♏ 10.-60. (0.6-4.0); horses, ʒ 1-4 (4.-15.) Adrenalin should be

repeated once in two hours when given internally as an hemostatic. It is an expensive drug.

Cantharis. Cantharides. (U. S. & B. P.)

Synonym.—Spanish flies, blister beetles, muscæ hispanicæ, E.; cantharides, Fr.; spanische fliegen, canthariden, G.; cantharides, P. G.

Cantharis is the beetle, Cantharis vesicatoria De Geer (class Insecta; order Coleoptera) thoroughly dried at a temperature not exceeding 104° F.

Habitat.—Southern Europe, Germany and Russia; living chiefly on Oleaceæ and Caprifoliaceæ.

Description.—About 25 Mm. long and 6 Mm. broad; flattish cylindrical, with filiform antennæ, black in the upper part, and with long wing-cases, and ample, membranous, transparent, brownish wings, elsewhere of a shining, coppery-green color. The powder is grayish-brown, and contains green shining particles. Odor strong and disagreeable; taste slight, afterwards acrid.

Constituents.—1, the active principle is cantharidin, $C_{10}H_{12}O_4$ (2 per cent.), in colorless scales, insoluble in water, soluble in alcohol, ether, chloroform, oils, acetic acid and acetic ether; it is found chiefly in the generative organs, eggs, and blood of the beetles; 2, a volatile oil; 3, a bland, green oil; 4, acetic and uric acids, extractives and salts; cantharides deteriorates with age and should be kept unpowdered in tightly stoppered bottles.

Dose.—H. & C., gr. v.-xx. (.3-1.3); Sh. & Sw., gr. iv.-viii. (.25-.5); D., gr. i.-ii. (.06-.12).

PREPARATIONS.

Tinctura Cantharidis. Tincture of cantharides. (U. S. & B. P.)

Made by percolation of cantharides, 100; with alcohol to make 1000. (U. S. P.)

Dose.—H. & C., ʒ ii.-iv. (8.-15.); D., ♏ii.-xv. (.12-1.).

Ceratum Cantharidis. (U. S. P.)

Cantharidis powdered, 320; petrolatum, wax, rosin and lard to make 1000.

Unguentum Cantharidis. (B. P.)

Action External.—Cantharides, by virtue of cantharidin, is an intense irritant. When applied to the skin in ointment it produces no effect for several hours, but after that time causes dilatation of the cutaneous vessels, hyperemia, and blisters, which appear in from

3 to 12 hours. The blisters soon break, discharge their serous contents, and then dry and crust the surface. If the action of cantharides is maintained continuously; if the application is repeated, or covered with a bandage; or if the skin was previously inflamed, then inflammation of the deeper-seated parts ensues, followed by suppuration, sloughing, loss of tissue, destruction of hair follicles, and scars. The drug is therapeutically a rubefacient and vesicant, and counter-irritant, in occasioning dilatation of the superficial vessels, and reflexly, contraction of those in the remote underlying parts. Cantharides acts more powerfully on the skin of horses and dogs, than on that of cattle and swine. If applied over an extensive surface, absorption and poisoning may occur.

Action Internal.—Cantharides affects mainly the digestive and genito-urinary tracts. It is a violent gastro-intestinal irritant. Toxic doses cause vomiting, in animals capable of the act, at first bilious (and containing greenish specks of the wings and wing cases), then mucous, and finally bloody. There is purging in all, associated with great pain and straining, of a mucous, fibrinous, and often hemorrhagic character. There are salivation, swelling and pain in the salivary glands. The gastro-enteritis is accompanied by general prostration, and feeble, rapid pulse. A few hours after the occurrence of the preceding symptoms there is enough absorption of cantharidin to induce lumbar pain, followed by frequent, scanty and painful micturition (strangury). The urine is albuminous and often bloody. Cantharides is eliminated chiefly by the kidneys, but also to some extent by the other excretory organs, including the skin. Sexual excitement may be present in poisoning. It is more common with small than large toxic doses. There are erections and great heat in the penis, and even inflammation and sloughing of the organ. Abortion is precipitated in the pregnant, and "heat" is hastened in the non-pregnant female. Stupor, coma, and collapse close the scene after lethal doses. Twenty grains of cantharides have killed a man; forty, a dog; and one drachm has destroyed a horse.

The treatment includes the use of emetics or the stomach tube; opium, to relieve pain and strangury; albuminous, mucilaginous drinks; and, in collapse, external heat, alcoholic stimulants, camphor, digitalone, strychnine and atropine under the skin. Oils and fats dissolve cantharidin and must not be given in poisoning as demulcents.

Post-Mortem Appearances.—Swelling, congestion, ecchymoses, and erosion of the gastro-intestinal mucous membrane are observed after death by cantharides. There are, moreover, lesions of acute nephritis and cystitis, with inflammation of the whole genito-urinary

mucous membrane. Hyperemia of the brain and spinal cord have also been reported.

Uses External.—Cantharides is employed more frequently than any other counter-irritant, to cause blistering, in veterinary practice. The reader is referred to the section on counter-irritants (p. 626) for an account of their actions. The action of cantharides is too tardy and irritating, and there is too much danger of absorption and poisoning to recommend it for the production of counter-irritation over an extensive area (chest and abdomen) in acute pulmonary congestion, pneumonia, bronchitis, colic, enteritis and peritonitis. Mustard, turpentine, and external heat are generally preferable in these disorders.

A blister of cantharides is serviceable in pericarditis and pleuritis with effusion, and, applied over the throat in severe, acute laryngitis, may obviate the necessity of tracheotomy. Again, blisters are useful on the poll in inflammation of the brain and its membranes; and over the spine in myelitis and meningitis; over the lumbar region in paraplegia.

A cantharidal application is often efficacious in muscular or joint rheumatism when placed over the affected area, or near by, in acute conditions. Furthermore, a cantharides blister is of advantage in acute diseases of the ear, when rubbed in above and behind this organ; and will relieve pain in the stomach, and vomiting when applied to the epigastrium.

Cantharides is *the* remedy usually employed in the treatment of diseases of the bones, joints, bursæ, ligaments, and tendons. In exostoses, as spavin and ringbone, the ointment is used most effectively after the actual cautery, to secure absorption and resolution, or anchylosis. Cantharidal ointment is often sufficient, together with complete rest, in the treatment of synovitis, and strains of tendons and ligaments. A cantharides blister is, sometimes, beneficial in hastening the formation of abscesses ("strangles"); or to aid their resolution after paracentesis; also to stimulate indolent ulcers or wounds; and to assist absorption of traumatic indurations, when applied around these lesions. The actual cautery, followed by a cantharides blister, will cause swelling and close the opening in the abdominal parietes of small umbilical hernias of foals and calves.

Likewise, blisters are valuable in closing and sealing punctured wounds into joints and synovial cavities.* Cantharides is commonly employed in ointment (1 to 4 to 8) made by melting and mixing the excipients in a double boiler; *i.e.*, over a water bath, and stirring in thoroughly the powdered drug. The following is a good preparation:

* The U. S. P. cerate may be used, as it is a powerful preparation. Its strength is 32 per cent. cantharides.

℞

Pulv. Cantharidis.
Ceræ flav.....āā ʒ ii.
Adipis ..... ʒ xiv.
M.
S. External use.

More powerful ointments are made with powdered euphorbium and cantharides, each 2 parts; corrosive sublimate, 1 part; vaseline, 8 parts; cerate, 12 parts; or,

Tar and resin, each 4 parts; yellow wax, 3 parts; cottonseed oil, 10 parts; powdered euphorbium, 2 parts; cantharides, 6 parts.

The technique of blistering consists in cutting the hair and washing the part to be blistered, and rubbing the blister long and thoroughly into the skin. The animal should be controlled by tying up the head, or using a cradle, or side-bar attached to the halter and surcingle, to prevent horses from biting the blistered area. The tail should be tied up if the blister is applied within its reach. Dogs should be muzzled, but are apt to rub the sore spot. The serum discharged from the blister must be continually sponged off with soap suds and water, to prevent excoriation of the subadjacent skin, or the latter may be covered with rosin cerate, or, better, a solution of rosin in alcohol, by means of a brush.

The blister is washed off in 36 or 48 hours after its application, and vaseline should thereafter be kept on the part. The use of cantharidal blisters is contraindicated in weak or young animals; on the flexures of joints; or delicate skin on the inner aspect of the upper part of the limbs; on acutely inflamed areas; and in renal disease.

Uses Internal.—Cantharides is rarely administered internally. It is sometimes successful in stopping incontinence of urine, when due to relaxation of the neck of the bladder, and it may be used as a stimulant in chronic cystitis and pyelitis. Cantharides is recommended to increase sexual desire in cows and mares, but it has usually to be given in toxic doses to produce an aphrodisiac action. The tincture should be employed when the drug is exhibited internally.

Adeps. Lard. (U. S. & B. P.)

Synonym.—Adeps præparatus, B. P.; axungia, axungia porci s. porcina, prepared lard, hog's lard, E.; axonge, graisse de porc, Fr.; schweineschmalz, G.; adeps suillus, P. G.

The prepared internal fat of the abdomen of the hog (Sus Scrofa Var. domesticus Gray.) (class Mammalia; order Pachydermata), purified by washing with water, melting, and straining.

Properties.—A soft, white, unctuous solid, having a faint odor free from rancidity, and a bland taste; insoluble in water; slightly soluble in alcohol; readily soluble in ether, chloroform, carbon disulphide, or benzin. Spec. gr. about 0.917 at 77° F.

PREPARATIONS.

Ceratum. Cerate. (U. S. P.)

Synonym.—Cerat simple, Fr.; einfaches cerat, wachssalbe, G. White wax, 300; white petrolatum, 200; benzoinated lard, 500.

Unguentum. Ointment. (U. S. P.)

Synonym.—Unguentum simplex, B.P.; simple ointment, E.; pommade simple, Fr.; wachssalbe, G. Lard, 800; white wax, 200. (U. S. P.)

Ceratum Resinoe. (See p. 459.)

Adeps Benzoinatus. (See p. 464.)

Sevum Preparatum. Prepared Suet. (U. S. & B. P.)

Synonym.—Sevum præparatum, B. P.; mutton suet, E.; suif, Fr.; talg, hammeltalg, G.; sebum, P. G.

The internal fat of the abdomen of the sheep Ovis aries Linné (class Mammalia; order Ruminantia), purified by melting and straining.

Properties.—A white, solid fat, nearly inodorous, and having a bland taste when fresh, but becoming rancid on prolonged exposure to the air. Insoluble in water or cold alcohol; soluble in about 60 parts of ether, and slowly in 2 parts of benzin.

Constituents.—1, olein; 2, stearin; 3, palmitin; 4, hircin.

Adeps Lanæ Hydrosus. Hydrous Wool Fat. (U. S. & B. P.)

Synonym.—Lanolin, œsypum.

The purified fat of the wool of sheep (Ovis aries, Linné; class Mammalia; order Ruminantia), mixed with not more than 30 per cent. of water.

Properties.—A yellowish-white, or nearly white ointment-like mass, having a faint, peculiar odor. Insoluble in water, but miscible with twice its weight of the latter, without losing its ointment-like character.

Constituents.—1, cholesterin, $C_{26}H_{43}$ (OH); 2, ethers of oleic, stearic, palmitic and other acids.

Adeps Lanæ. (U. S. & B. P.)

(Wool fat without water.)

ACTION AND USE OF LARD, SUET, AND HYDROUS WOOL FAT.

Lard is used mainly as a basis of ointments and cerates. Benzoin is commonly added to it to prevent or retard rancidity. Lard is inferior to petrolatum as a lubricant. It is rarely given internally as an antidote to caustic alkalies, and as a demulcent.

Suet is contained in certain ointments and plasters. It is harder than lard and becomes rancid on prolonged exposure. Lanolin is not subject to rancidity, but possesses no particular medicinal action. It is indicated where absorption of some drug is desired (mercury, potassium iodide) by inunction, as it is believed to be more readily absorbed from the skin than any other fat. Lanolin is used as a basis of ointments. It may be mixed with twice its weight of water without losing its ointment consistency.

Cera Flava. Yellow Wax. (U. S. & B. P.)

Synonym.—Cera citrina, beeswax, B. P.; cire jaune, Fr.; gelbes wachs, G.

A solid substance prepared from the honey comb of the bee, Apis mellifica Linné (class Insecta; order Hymenoptera).

Properties.—A yellowish to brownish-yellow solid, having an agreeable, honey-like odor, and faint, balsamic taste. Spec. gr. 0.951-0.960. It is brittle when cold; by the heat of the hand it becomes plastic. Insoluble in alcohol; sparingly soluble in cold alcohol, but completely soluble in ether, chloroform, fixed and volatile oils.

Constituents.—1, myricin or myrical palmitate ($C_{30}H_{61}$, $C_{16}H_{31}O_2$), a spermaceti-like substance; 2, cerin or cerotic acid ($C_{27}H_{54}O_2$), an imperfectly saponifiable waxy body; 3, hydrocarbons ($C_{27}H_{56}$ and $C_{34}H_{64}$); 4, an alcohol ($C_{25}H_{52}O$); 5, ceryl alcohol ($C_{27}H_{56}O$); 6, hydrocarbons, 12 per cent.

Cera Alba. White Wax. (U. S. & B. P.)

Synonym.—Cire blanche, Fr.; weisses wachs, G.

Yellow wax, bleached by exposure to air, light and moisture.

Properties.—A yellowish-white solid, somewhat translucent in thin layers, having a slightly rancid odor, and an insipid taste. Spec. gr. 0.950-0.960. Solubility and composition the same as those of yellow wax.

Uses.—Yellow and white wax are used as bases for plasters, ointments and cerates, since they do not decompose nor melt at the temperature of the body.

Cetaceum. Spermaceti. (U. S. & B. P.)

A peculiar, concrete, fatty substance, obtained from (the head of the sperm whale) Physeter macrocephalus Linné (class Mammalia; order Cetacea).

Habitat.—Indian and Pacific Oceans.

Properties.—White, somewhat translucent, slightly unctuous masses of a scaly-crystalline fracture and a pearly lustre; odorless, and having a bland, mild taste. It becomes yellow and rancid by exposure to the air. Spec. gr. 0.938 to 0.944. Insoluble in water, nearly so in cold alcohol; soluble in ether, chloroform, carbon disulphide, fixed and volatile oils.

Constituents.—1, chiefly a fat, cetin or cetyl palmitate ($C_{16}H_{33}C_{16}H_{31}O_2$), composed of cetylic alcohol ($C_{16}H_{33}OH$) and palmitic acid ($HC_{16}H_{31}O_2$); 2, sperm oil, a small quantity.

PREPARATION.

Unguentum Cetacei. (B. P.)

Spermaceti, white wax, and olive oil. Made by melting and mixing.

Action and Uses.—Spermaceti resembles wax. It is used as an emollient and as a basis for plasters, ointments, and cerates. It is rarely used alone.

Mel. Honey. (U. S. & B. P.)

Synonym.—Miel, Fr.; honig, G.

A saccharine secretion deposited in the honeycomb by the bee, Apis mellifica Linné (class Insecta; order Hymenoptera).

Properties.—A syrupy liquid of a bright yellowish to a pale-yellowish-brown color; translucent when fresh, but gradually becoming opaque and crystalline; having a characteristic, aromatic odor, and a sweet, faintly acrid taste. Nearly soluble in water.

Constituents.—1, grape sugar (dextrose); 2, fruit sugar (glucose); 3, a volatile oil; 4, wax; 5, formic acid, a trace. Fresh honey contains sucrose or cane sugar, which is changed into grape and fruit sugars.

PREPARATION.

Mel Depuratum. Clarified Honey. (U. S. & B. P.)

Synonym.—Mel depuratum, P. G.; miel despumé, mellite simple, Fr.; gereinigter honig, G.

Derivation.—Melt honey with two per cent. of its weight of paper-pulp in water bath; skim, strain, and add five per cent. of its weight of glycerin.

Dose.—Ad lib.

Honey is employed as an excipient in electuaries and confections. It is a demulcent and mild laxative for young animals. Oxymel (clarified honey, 8 parts; water and acetic acid, each 1 part) is a soothing preparation for the throat.

SACCHARUM LACTIS. Sugar of Milk. ($C_{12}H_{22}O_{11} + H_2O$.) (U. S. & B. P.)

Synonym.—Lactose, lactin, milk sugar, E.; sucre de lait, Fr.; milchzucker, G.

A peculiar, crystalline sugar obtained from the whey of cows' milk, by evaporation, and purified by recrystallization.

Properties.—White, hard, crystalline masses, yielding a white powder, feeling gritty on the tongue; odorless, and having a faintly sweet taste. Permanent in the air. Soluble in about 4.79 parts of water; insoluble in alcohol, ether, or chloroform.

Dose.—Ad lib.

Uses.—Sugar of milk is less soluble and therefore less sweet than cane sugar. It is harder, and thus assists in the subdivision of drugs, and serves as a vehicle in the making of powders and triturates. It also forms the basis of homeopathic preparations.

Sugar of milk is a considerable diuretic and may be given to dogs in 2 to 4 drachm doses daily, in solution in the drinking water, for dropsy of renal or cardiac origin.

PEPSINUM. Pepsin. (U. S. & B. P.)

A proteolytic ferment or enzyme obtained from the glandular layer of fresh stomachs from healthy pigs, and capable of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumen.

Derivation.—The chopped mucous membrane of a pig's stomach is macerated for several days in a weak, aqueous solution of hydrochloric acid, with frequent stirring. The pepsin is precipitated from this solution by the addition of sodium chloride and rises to the

surface. The floating mixture is skimmed off, drained, pressed and dried. Sometimes the surface of the clean mucous membranes of the stomach of pigs, calves, or sheep is simply scraped off and dried.

Properties.—Lustrous white, pale yellow or yellowish, transparent or translucent scales or grains, or a fine white or cream-colored amorphous powder, free from any offensive odor, and having a slightly acid or saline taste. It should be not more than slightly hygroscopic.

Soluble, or almost entirely soluble, in about 50 parts of water, the solution having more or less opalescence; more soluble in water acidulated with hydrochloric acid; insoluble in alcohol, ether or chloroform.

Pepsin, when in solution, is incompatible with alkalies, alkaline earths, or alkali carbonates.

Dose.—D., Calves and Foals, gr. x.-3 i. (.6-4.).

PREPARATIONS.

Glycerinum Pepsini. (B. P.)

(Contains hydrochloric acid, 3 i. = gr.v. pepsin.)

Dose.—D., 3 i.-ii.

Action and Uses.—Pepsin is of some value in the treatment of dogs and young animals. It assists the digestion of proteids in the stomach, but has no action on fat or carbohydrates of the food. The drug should usually be given along with hydrochloric acid, which converts any pepsinogen, in the gastric tubules, into pepsin. Pepsin contains the unorganized digestive ferment of the gastric juice, but is not by any means the *pure* ferment, which has never been isolated.

Much of the commercial pepsin is inert, or is composed largely of mucus, albumin and peptone, which later gives the preparation a musty odor and causes it to absorb moisture when exposed to the air, and to become sticky.

Pepsin is serviceable in gastric indigestion of young animals, which is sometimes accompanied by diarrhea, and in dyspepsia and feeble digestion caused by acute illness. Its use must not be long persisted in, as the normal functions of the stomach will fail from lack of use. Pepsin is administered in pill, or solution with hydrochloric acid.

Pancreatinum. Pancreatin. (U. S. P.)

Synonym.—Zymine, B. P.

A mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of

the hog (*Sus scrofa,* var. *domesticus* Gray), or the ox (*Bos taurus* Linné), and consisting principally of amylopsin, myopsin, trypsin, and steapsin, and proved to be capable, when assayed, of converting not less than 25 times its own weight of starch into substances soluble in water.

Derivation.—Chopped hog's pancreas is macerated in a dilute aqueous solution of hydrochloric acid for 48 hours, and pancreatin, which is separated by adding a saturated solution of sodium chloride, rises to the surface and is skimmed off, drained, washed, and when nearly dry, is diluted with sugar of milk until 10 grains will exactly emulsify 2 drachms of cod-liver oil.

Properties.—A yellowish, yellowish-white or grayish, amorphous powder; odorless, or having a faint, peculiar, not unpleasant odor, and a somewhat meat-like taste. Slowly and almost completely soluble in water; insoluble in alcohol.

Dose.—D., gr. v.-xv. (.3-1.).

Action and Uses.—Pancreatin fulfils a fourfold function by virtue of the four ferments contained in it. It digests proteids by means of the ferments, *trypsin* and *myopsin;* it decomposes and emulsifies fat owing to the ferment, *steapsin;* it converts starch into sugar by reason of the ferment, *amylopsin;* it coagulates milk through the action of a *milk-curdling ferment.* Pancreatin is thus more useful than pepsin on account of its more extended actions.

It does not digest food in an acid medium, but may aid digestion in the stomach, before much gastric juice has been secreted, during the first half hour after the ingestion of food. Pancreatin acts more efficiently in intestinal indigestion because of the presence of an alkaline secretion. For this reason pancreatin is commonly prescribed with sodium bicarbonate, and, if given for intestinal indigestion, it is administered in pill or tablet to dogs one or two hours after feeding. It is indicated in diarrhea, when the fecal movements contain particles of undigested food, and in other forms of deficient digestion due to general disease. Pancreatin is more especially valuable to digest food previous to its administration by the mouth or rectum (see Artificial Feeding, p. 624). For this purpose a good preparation can be made extemporaneously by washing and cutting up a fresh pig's pancreas, soaking it in absolute alcohol for 24 hours, pressing out the alcohol, macerating it in ten times its weight of glycerin for 48 hours, and filtering. The filtered glycerin extract is added in the proportion of 3 i. to the pint of warm milk, with a little sodium bicarbonate, to artificially digest it.

Fel Bovis. Oxgall. (U. S. P.)

Synonym.—Fel tauri, inspissated oxgall, E.

The fresh bile of Bos Taurus Linné (class Mammalia; order Ruminantia).

Properties.—A brownish-green or dark green, somewhat viscid liquid, having a peculiar, unpleasant odor, and a disagreeable, bitter taste. Spec. gr. 1.015 to 1.025. It is neutral, or has a slightly alkaline reaction.

PREPARATION.

Fel Bovis Purificatum. Purified Oxgall. (U. S. P.)

Synonym.—Fel bovinum purificatum, B.P.; fiel de boeuf purifie, Fr.; gereinigte ochsengalle (rindsgalle), G.

Evaporate oxgall, 300, to 100; add alcohol, 100. The alcohol is distilled off from the decanted and filtered solution, and the remainder evaporated to pilular consistence.

Properties.—A yellowish-green, soft solid, having a peculiar odor and a partly sweet and partly bitter taste. Very soluble in water and alcohol.

Dose.—Same as for oxgall.

Dose.—D., gr. v.-xv. (.3-1.).

Actions and Uses.—Purified oxgall contains all the active elements of bile,—biliary acids, coloring matter and cholesterin. One part of oxgall represents about fifteen parts of bile. Most of the bile ingested is absorbed from the stomach (where it may act as a simple bitter), and small intestines, and is carried to the liver. From the liver it is not only excreted again into the bowel but it also stimulates the secreting cells of the liver (by means of bile acids) and increases the secretion of bile. Bile is in fact the only certain cholagogue known.

Bile has but a feeble antiseptic action, yet it excites the secretion of the pancreatic fat-splitting ferment and aids the absorption of fat in the food. In thus aiding digestion it prevents the fetid feces seen in biliary obstruction. Bile, moreover, assists the solubility and action of certain cathartics, viz., podophyllum, rhubarb, scammony, aloes and jalap—and has a laxative action itself, probably through the irritation of bile acids on the large intestines. Bile is indicated medicinally in obstruction to the normal flow of bile—to aid intestinal digestion—and also to facilitate the action of the cathartics noted above. It may be used also to advantage in enema for dogs with chronic constipation and impacted feces (2 drams to 2 ounces of water). Internally it is given to dogs in pills 2 hours after meals.

Papain. (Non-official.)

Synonym.—Papayotine, papaya, papayine, papoid.

A digestive ferment obtained from the juice of the unripe fruit of Carica papaya (Papaw), an herbaceous tree growing in the East and West Indies. Papain or papayotine are often used to describe the dried juice itself, which exists in the form of a powder similar to that of gum arabic. Papain occurs in the form of a white, or greyish-white, nearly tasteless powder, soluble in glycerin and water. Papain is said to digest both proteids and carbohydrates, in either an acid or alkaline medium, and is recommended in gastric or intestinal indigestion in pill or powder. It has also been used to destroy pyogenic membrane of fistulæ and abscess, in 5 per cent. solution; or tumors and malignant growths, injected into the tissues in 10 per cent. solution. This latter use is accompanied by pain and febrile temperature, although the substance is said to merely dissolve diseased tissues without caustic effect. Papain may be given to dogs, foals, or calves in doses of gr. ii.-x. (.12-.6).

Oleum Morrhuæ. Cod liver oil. (U. S. & B. P.)

Synonym.—Oleum jecoris ascelli, P. G.; oleum hapatis morrhuæ, cod oil, E.; huile de morue, huile de foie de morue, Fr.; leberthran, stockfischleberthran, G.

A fixed oil obtained from fresh livers of Gadus morrhua Linné and other species of Gadus (class Pisces; order Teleostei; family Gadidæ).

Habitat.—North Atlantic Ocean.

Properties.—A pale-yellow, thin, oily liquid, having a peculiar, slightly fishy, but not rancid odor, and a bland, slightly fishy taste. Spec. gr. 0.918 to 0.922. Scarcely soluble in alcohol, but readily soluble in ether, chloroform or carbon disulphide; also in 2.5 parts of acetic ether. Brown oils are not desirable therapeutically.

Constituents.—1, glycerin oleate, 70 per cent.; 2, palmitin and stearin, 25 per cent.; 3, oleic, margaric, palmitic, stearic, butyric and acetic acids, in small quantities; 4, biliary matter, as cholic, fellinic and bilifellinic acids; 5, gaduin ($C_{35}H_{46}O_9$); 6, morrhuol, a crystalline substance containing iodine, phosphorus and bromine; 7, traces of iron, lime, and magnesia; 8, decomposition products or cadaveric alkaloids, in brown oils.

Dose.—H. & C., ℥ ii.-v. (60.-120.); Sh. & Sw., ℥ ss.-i. (15.-30.); D. & C., ʒ i.-iii. (4.-12.).

Action Internal.—Cod liver oil resembles other oils in aiding nutrition, the accumulation of fat, and the maintenance of bodily

heat, but surpasses them in three particulars: 1, cod liver oil is more easily absorbed; this has been proven comparatively by injecting various oils into separate ligated portions of the living animal bowel; 2, cod liver oil is more readily oxidized after absorption; this is shown by the fact that it reduces and therefore changes the color of potassium permanganate solutions more quickly than other oils; 3, cod liver oil increases the number of red blood corpuscles in anemia; this has been demonstrated by blood-counts, but not by comparison with the effect of other oils. The ease of absorption is thought by some to be due to biliary principles which aid the diffusion of substances through a mucous membrane (osmosis) when the latter is moistened by bile; by others it is attributed to the presence of free acids in the oil which would tend to saponify and emulsify the drug. The medicinal superiority of cod liver oil has led many writers to classify it as an alterative, and special properties have been referred to the minute traces of iodine, phosphorus, and bromine in the oil. These agents exist in too infinitesimal an amount to exert much therapeutic action.

It is probable that no one constituent, or group of constituents, yet separated from the oil truly represent its medicinal effect. Cod liver oil is inferior to other oils in one respect, however, and this consists in its liability to cause nausea, indigestion, diarrhea and vomiting, in large doses and in some patients.

Administration.—Cod liver oil may be given pure, or if this does not agree, it may be exhibited in various ways: 1, with an equal quantity of lime water and a little syrup; 2, with ether (℥x.), small animals; ʒ i. to large animals; or with whisky; 3, shaken with white of an egg, or mucilage of tragacanth, and a few drops of oil of peppermint; 4, to dogs, in one of the proprietary emulsions, or with malt extract. The oil should be given after feeding and administration begun with the smaller doses as recommended above.

Uses.—Cod liver oil is indicated generally in conditions of malnutrition occurring primarily; in the course of chronic diseases; or following acute diseases. It is especially indicated in diseases of the respiratory tract, when it improves the nutrition of the mucous membranes, as well as the general nutrition. Thus cod liver oil is one of the best remedies in tardy convalescence from canine asthma and distemper; from influenza, bronchitis, pneumonia and strangles in horses; also in "heaves," emphysema, or broken wind in horses. Carron oil is cheaper and very efficient in the latter disorder, given on the food.

Cod liver oil is valuable in the treatment of chronic bronchitis, chronic eczema, and chorea of dogs; and in rickets, anemia, weakness, and emaciation in all young animals. It often proves curative

in various forms of muscular and chronic articular rheumatism, and facilitates the absorption of chronically enlarged glands. The use of cod liver oil is contra-indicated in hot weather, and in animals suffering from indigestion or acute diarrhea. It is often beneficial, however, in chronic diarrhea.

Linseed oil, oil cake, and cottonseed meal may often be conveniently and properly substituted for cod liver oil, in the case of the large patients; while morrhuol (gr. iii. = 1 teaspoonful cod liver oil?) given in pills, or lipanin (oleic acid, 6; olive oil, 100) may be exhibited in drachm doses to dogs when cod liver oil does not agree.

Ichthyolum. Ichthyol. (Non-official.)

Synonym.—Ammonium ichthyol sulphonate.

Derivation.—A bituminous quartz occurring in the Tyrol Mountains, containing the fossil remains of fish, is distilled with strong sulphuric acid, and sulphurous acids are removed from the distillate by sodium chloride, while sulphonic acid separates out. The latter is usually saturated with ammonia, forming ichthyol; but similar preparations are made by the combination of sulphonic acid with sodium, lithium and zinc.

Properties.—A thick, dark, reddish-brown liquid, of a tarry consistency, and possessing a peculiar, disagreeable odor and hot, bituminous taste. It is soluble in water, glycerin, alcohol, benzol, fats and fixed oils.

Constituents.—Ichthyol contains about 15 per cent. of sulphur; also an inseparable volatile oil, to which its disagreeable odor is due.

Action and Uses.—Ichthyol is one of the most widely used drugs recently introduced into medicine. It is employed in the treatment of acute and chronic diseases of the skin and subadjacent tissues, accompanied with inflammation, pain, swelling, and induration; also in epidermal proliferation. Ichthyol is supposed to readily permeate the skin, and there act to relieve inflammation and pain, and aid resolution. It is one of the most commonly prescribed remedies in chronic eczema and urticaria; in erysipelas, muscular and articular rheumatic disorders; and in bruised and strained muscles, tendons and ligaments. The drug is commonly used in the treatment of frost bites, burns, and in causing absorption of lymphatic enlargements. Ichthyol is recommended as a cure for sarcoptic mange and scab. The drug is somewhat antiseptic, and is a stimulant, anodyne and resolvent to the skin, locally. Ichthyol is most satisfactorily applied to the unbroken skin in 25 to 50 per cent. ointment, with lanolin or lard. Solutions in water, glycerin, oils or alcohol, are sometimes

employed of various strengths. Ichthyol is rarely given internally for chronic rheumatism. While the drug has had the widest use and commendation, and in the most diverse lesions, yet its reputation is waning and was not founded on any solid basis—unless that of its unusually vile odor.

Thiol is a substitute for ichthyol, lacking the unpleasant odor of the latter medicament. Thiol is derived from brown-colored paraffin or gas-oils, by a complicated process, and consists of a mixture of sulphureted hydrocarbons. The drug exists in two forms: 1, thiolum liquidum, a thin, brownish-black liquid, soluble in water and glycerin; 2, thiolum siccum, occurring in lustrous scales. Thiol is cheaper than ichthyol and is said to be as efficacious as the latter. This remains to be proved. Liquid thiol is employed in 10 per cent. aqueous solution or in ointment; and thiolum siccum in powder, dusted on inflamed parts, as in acute moist eczema.

DOSES OF DRUGS.

In the following table three doses are usually given for each drug. The first dose is for horses and cattle, in both the apothecaries' and metric systems of weights and measures. The second dose is for sheep and swine, in both the apothecaries' and metric systems of weights and measures. The third dose is for dogs (and also cats) in both the apothecaries' and metric systems of weights and measures.

Letters are used to signify the name of the animal for which the dose is intended. Thus: H., Horses; C., Cattle; Sh., Sheep; Sw., Swine; D., Dogs (which also includes cats in most cases).

The followng abbreviations are also employed: lb., pound; pt., pint; oz., ounce; dr., drachm; m., minim; gr., grain; gm., gram; cc., cubic centimeter. These doses are suitable for animals of average weight.

Dose Table.

Acetanilid.—H. & C., dr. 1-2 (gm. 4.-8.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 3-7 (gm. .2-.5).

Acetum Opii.—H., oz. 1-2 (cc. 30.-60.). C., oz. 2-3 (cc. 60.-90.). Sh. & Sw., dr. 2-6 (cc. 8.-24.). D., m. 3-20 (cc. .2-1.3).

Acid, Arsenous.—H. & C., gr. 2-3 (gm. .12-.2); single dose, gr. 5-10 (gm. .3-.6). Sh. & Sw., gr. 1-2 (gm. .06-.12). D., gr. 1/30-1/10 (gm. .002-.006).

Acid, Benzoic.—H., dr. 2-4 (gm. 8.-15.). D., gr. 5.-15 (gm. .3-1.).

Acid, Boric.—H., dr. 2-4. (gm. 8.15.). D., gr. 5-15 (gm. .3-1.).

Acid, Carbolic.—H. & C., gr. 15-30 (gm. 1.-2.). Sh. & Sw., gr. 5-10 (gm. .3-.6). D., gr. ½-1 (gm. .03-.06).

Acid, Citric.—H., dr. 2-4 (gm. 8.-15.). D., gr. 10-20 (gm. .6-1.3).

Acid, Gallic.—H. & C., dr. 2-4. (gm. 8.-15.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-20 (gm. .3-1.3).

Acid, Hydriodic (syrup of).—D. dr. 1 (cc. 4.).

Acid, Hydrochloric (dilute).—H., dr. 1-2 (cc. 4.-8.). C., dr. 2-4 (cc. 8.-15.). Sh. & Sw., m. 15-20 (cc. 1-1.3). Sw. & D., m. 5-20 (cc. .3-1.3).

Acid, Hydrocyanic (dilute).—H. & C., m. 20-40 (cc. 1.3-2.6). Sh., m. 10-15 (cc. .6-1.). Sw., m. 2-5 (cc. .12-.3). D., m. 1-3 (cc. .06-.2).

Acid, Lactic.—H. & C., dr. 2-4 (cc. 8.-15.). D., dr. ½-1 (cc. 2.-4.).

Acid, Nitric (dilute).—H., dr. 1-2 (cc. 4.-8.). C., dr. 2-4 (8.-15.). Sh., dr ½-1 (cc. 2.-4.). Sw. & D., m. 5-30 (cc. .3-2.).

Acid, Nitrohydrochloric.—H., m. 20-40 (cc. 1.3-2.6). D., m. 3-5 (cc. .2-.3).

Acid, Nitrohydrochloric (dilute).—H., dr. 1-2 (cc. 4.-8.). C., dr. 2-4 (cc. 8.-15.). Sh., dr. ½-1 (cc. 2.-4.). Sw. & D., m. 5-30 (.3-2.).

Acid, Phosphoric (dilute).—H., dr. 1-2 (cc. 4.-8.). C., dr. 2-4 (cc. 8.-15.). Sh. & Sw., dr. ½-1 (cc. 2.-4.). D., m. 5-30 (.3-2.).

Acid, Salicylic.—H. & C., dr. 2-8 (gm. 8-30). Sh., dr. 1-4 (gm. 4.-15.). Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-30 (gm. .3-2.).

Acid, Sulphuric (dilute).—H., dr. 1-2 (cc. 4.-8.). C., dr. 2-4 (cc. 8.-15.). Sh., dr. ½-1 (cc. 2.-4.). Sw. & D., m. 10-30 (cc. .6-2.).

Acid, Sulphuric, Aromatic.—H., dr. ½-1 (cc. 2.-4.). C., dr. 2.-4. (cc. 8.-15.). Sh., m. 15-30 (cc. 1.-2.). Sw. & D., m. 5-15 (cc. .3-1.).

Acid, Sulphurous.—H. & C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., dr. ½-2 (cc. 2.-8.).

Acid, Tannic.—H. & C., dr. ½-4 (gm. 2.-15.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 1-15 (gm. .06-1.).

Acid, Tartaric.—H. & C., dr. 2-4 (gm. 8.-15.). D., gr. 10-30 (gm. .6-2.).

Aconite.—H., gr. 3-20 (gm. .2-1.3). D., gr. $\frac{1}{10}$-2 (gm. .006-.12).

Aconite, Extract of Leaves.—H., gr. 3-6 (gm. .2-.4). D., gr. ½-1 (gm. .03-.06).

Aconite, Extract of.—H., gr. 1-3 (gm. .06-.2). D., gr. $\frac{1}{10}$-¼ (gm. .006-.015).

Aconite, Fluidextract of.—H., m. 3-20 (cc. .2-1.3). D., m. $\frac{1}{10}$-2 (cc. .006-.12).

Aconite, Tincture of.—H., m. xx.-3 i. (1.3-4.). C., 3 ss.-iss. (2.-6.); Sh. & Sw., m. x.-xx. (.6-1.3). D., m. ii.-x. (.12-.6).

Aconitine Nitrate (Squibb).—H., gr. $\frac{1}{30}$ (gm. .002). D., gr. $\frac{1}{400}$-$\frac{1}{200}$ (gm. .00015-.0003).

Adrenalin Solution.—(By mouth), H., dr. 2-4 (cc. 8.-15.). D., ♏10-60 (cc. 0.6-4.).

Aloes.—H., oz. ½-1 (gm. 15.-30.). C., oz. 1-2 (gm. 30.-60.). Sh., oz. ½-1 (gm. 15.-30.). Sw., dr. 2-4 (gm. 8.-15.). D., gr. 20-60 (gm. 1.3-4.).

Aloin.—H. & C., dr. 2-3 (gm. 8.-12.). D., gr. 2-20 (gm. .12-1.3).

Alum.—H. & C., dr. 2-4 (gm. 8.-15.). Sh. & Sw., gr. 20.-60. (gm. 1.3-4.). D., gr. 5-10 (gm. .3-.6). Emetic, dr. 1 (gm. 4).

Ammonia, Aromatic Spirit of.—H. & C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., dr. 2-4 (cc. 8.-15.). D., dr. ½-1 (cc. 2.-4.)

AMMONIA, Spirit of.—H. & C., oz. ½-1 (cc. 15.30.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 10-20 (cc. .6-1.3).

AMMONIA, Water of.—H. & C., oz. ½-1 (cc. 15.-30.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 10-20 (cc. .6-1.3).

AMMONIA, Stronger Water of.—H. & C., dr. 2-6 (cc. 8.-24.). Sh. & Sw., dr. 1 (cc. 4.). D., m. 5-10 (cc. .3-.6).

AMMONIUM, Solution of Acetate.—H. & C., oz. 2-4 (cc. 60.-120.). D., dr. 2-8 (cc. 8.-30.).

AMMONIUM BENZOATE.—H., dr. 2-4 (gm. 8.-15.). D., gr. 5-15 (gm. .3-1.).

AMMONIUM CARBONATE.—H., dr. 2 (gm. 8.). C., dr. 3-6 (gm. 12.-24). Sh. & Sw., gr. 15.-40. (gm. 1.-2.6). D., gr. 3-10 (gm. .2-.6). Emetic, D., gr. 15 (gm. 1).

AMMONIUM CHLORIDE.—H., dr. 2 (gm. 8.). C., dr. 3-6 (gm. 12.-24.) Sh. & Sw., gr. 15-40 (gm. 1.-2.6). D., gr. 3-10 (gm. .2-.6).

AMMONIUM VALERATE.—D., gr. 2-5 (gm. .12-.3).

AMYL NITRITE.—H., dr. ½-1 (cc. 2.-4.). D., m. 2-5 (cc. .12-.3), by inhalation.

ANISE.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-3 (gm. 8.-12.). D., gr. 10-30 (gm. .6-2.).

ANISE, Oil of.—H., m. 20-30 (cc. 1.3-2.). D., m. 1-5 (cc. .06-.3).

ANISE, Spirit of.—D., dr. 1-2 (cc. 4.-8.).

ANTIMONY AND POTASSIUM TARTRATE.—H., dr. 2-4 (gm. 8.-15.). Sw., emetic, gr. 4-10 (gm. .24-.6). D., gr. 1/10-½ (gm. .006-.03). Emetic, D., gr. 1-2 (gm. .06-.12).

ANTIMONY, Wine of.—D., m. 5-60 (cc. .3-4.)

ANTIPYRIN.—H. & C., dr. 3-4 (gm. 12.-15.). Sh. & Sw., dr. 1 (gm. 4). D., gr. 5-20 (gm. .3-1.3).

ANTI-STRANGLES ANTITOXIN.—H., 30 c.c. (see p. 667).

ANTISTREPTOCOCCUS SERUM.—H., 20-50 cc.

ANTITOXIN ANTI-STRANGLES.—H., 30 c.c. (see p. 667). Influenza—H., 30 to 90 c.c. (see p. 661). Tetanus—H., 10 c.c. as prophylactic (see p. 658).

APOMORPHINE HYDROCHLORIDE.—Subcutaneously—H., gr. ¾ (0.045). Foals, gr. ½ (0.03). Calves & Sheep, gr. ½ (0.03). Cows, gr. 1½ (0.09). D., gr. 1/10 to 1/5 (0.006-0.012) as emetic. By the mouth, as expectorant—D., gr. 1/40 to 1/25 (0.0015-0.0024).

ARECA NUT.—H., oz. ½-1 (gm. 15.-30.). Lamb, dr. 1 (gm. 4.). D., gr. 15-60 (gm. 1.-4.) Fowl, gr. 10-40.

ARECA, Fluidextract of.—Dose same as nut.

ARECOLINE HYDROBROMIDE.—H. & C., gr. ⅔-1½ (0.04-0.09); average dose subcutan., gr. i. (gm. 0.06).

ARSENIC.—See Acid, Arsenous.

Arsenic, Fowler's Solution of.—H. & C., dr. 2-8 (cc. 8.-30.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 2-10 (cc. .12-.6).

Asafetida.—H. & C., oz. ½-1 (gm. 15.-30.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 3-10 (gm. .2-.6).

Asafetida, Emulsion of.—D., oz. ½-1 (cc. 15.-30.).

Asafetida, Pill.—D., (1.-4.).

Asafetida, Tincture of.—H. & C., oz. 2-4 (cc. 60.-120.). D., dr. ½-1 (cc. 2.-4.).

Aspidium, Fluidextract of (B. P.).—H. & C., dr. 3-6 (cc. 12.-24.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 15-60 (cc. 1.-4.).

Aspidium, Oleoresin of.—H. & C., dr. 3-6 (cc. 12.-24.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 15-60 (cc. 1.-4.).

Aspirin.—H. & C., dr. 2-4 (gm. 8.-15.). D., gr. 5-20 (gm. 0.3-1.3).

Atoxyl.—H., gr. 5-15 subcut. (gm. 0.3-1.).

Atropine Sulphate.—H., gr. 1-1½ (gm. .06-.09). C., gr. 1-2 (gm. .06-.12). Sh. & Sw., gr. 1/15-1/12 (gm. .004-.005). D., gr. 1/120-1/80 (0.0005-.0008). Average dose, D., gr. 1/100 (gm. .0006).

Balsam of Peru.—H. & C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 10-30 (cc. .6-2.)

Barium Chloride.—By mouth, H., dr. 1-2 (gm. 4.-8.). Intravenously, H., gr. 15 (gm. 1.). By mouth, Cows, dr. 4 (gm. 15.). Calves, dr. 1 (gm. 4.).

Belladonna, Alcoholic Extract of Leaves.—H. & C., gr. 10-20 (gm. .6-1.3). Sh. & Sw., gr. 2-4 (gm. .12-.24). D., gr. ⅛-½ (gm. .008-.03).

Belladonna, Tincture of Leaves.—D., m. 15-30 (cc. 1.-2.).

Belladonna Root, Fluidextract of.—H., dr. 1-2 (cc. 4.-8.). C., dr. 2-3 (cc. 8.-12.). Sh. & Sw., m. 10-15 (cc. .6-1.). D., m. 1-3 (cc. .06-.2).

Benzoin, Tincture of.—H., oz. 1 (cc. 30.). D., dr. ½-1 (cc. 2.-4.)

Betula, Oil of.—See Gaultheria.

Bismuth Salicylate.—D., gr. 5-10 (gm. .3-.6).

Bismuth Subcarbonate.—H., dr. 2-4 (gm. 8.-15.). D., gr. 10-30 (gm. .6-2).

Bismuth Subnitrate.—Dose same as subcarbonate.

Brandy.—H. & C., oz. 2-4 (cc. 60.-120.). Sh. & Sw., oz. 1-2 (cc. 30.-60.). D., dr. 1-4 (cc. 4.-15.).

Buchu, Fluidextract of.—H., oz. 1-2 (cc. 30.-60.). D., m. 5-30 (cc. .3-2.).

Buckthorn (Rhamnus Catharticus), Syrup of.—D., oz. 1-2 (cc. 30.-60.). Cats, oz. ½-1 (cc. 15.-30.).

Caffeine.—H., 3 ss.-ii. (gm. 2.-8.). D., gr. ½-3 (gm. .03-.2).

Caffeine, Citrated.—H., 3 ii.-iv. (gm. 8.-15.). D., gr. 1-6 (gm. .06-.36).

Calamus.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2.3 (gm. 8.-12.). D., gr. 15-60 (gm. 1.-4.).

Calamus, Fluidextract of.—Dose same as Calamus.

Calcium, Precipitated Carbonate of.—H., oz. 1-2 (gm. 30.-60.). C.. oz. 2-4 (gm. 60.-120). Sh. & Sw., dr. 2-4 (gm. 8.-15.). D., gr. 10-60 (gm. 6-4).

Calcium Chloride.—H. & C., oz. ½-1 (gm. 15-30). D., gr. 5-20 (gm. .3-1.3).

Calcium, Lactophosphate, Syrup of.—Foals and Calves, oz. ½-1 (cc. 15.-30.). D., dr. 1-4 (cc. 4.-15.).

Calcium, Precipitated Phosphate of.—H., dr. 2-4 (gm. 8.-15.). C., oz. ½-1 (gm. 15.-30.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 5-20 (gm. .3-1.3).

Calomel.—See Mercury.

Calumba.—H. & C., oz. ½-1 (gm. 15.-30.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 5-30 (gm. .3-2.).

Calumba, Fluidextract of.—Dose same as Calumba.

Calumba, Tincture of.—H. & C., oz. 2-4 (cc. 60.-120.). D., dr. 1-4 (cc. 4.-15.).

Camphor.—H., dr. 1-3 (gm. 4.-12.). C., dr. 2-4 (gm. 8.-15.). Sh. & Sw., gr. 15-60 (gm. 1.-4.). D., gr. 3-20 (gm. .2-1.3.).

Camphor, Monobromated.—D., gr. 2-10 (gm. .12-.6).

Camphor, Liniment of.—H., subcut., oz. ½-i. (c.c. 15.-30.), not more than dr. 1½ injected at one point. D., m. 15-30 (c.c. 1.-2.).

Camphor, Spirit of.—H., oz. 1-2 (cc. 30.-60.). D., dr. ½-1 (cc. 2.-4.).

Cannabis Indica, Extract of.—H., dr. 1-2 (gm. 4.-8.). D., gr. ¼-1 (gm. .015-.06).

Cannabis Indica, Fluidextract of.—H., dr. 4-6 (cc. 15.-24.). D., m. 3-10 (cc. .2-.6).

Cannabis Indica, Tincture of.—D., m. 15-30 (cc. 1.-2.).

Cantharides.—H. & C., gr. 5-20 (gm. .3-1.3). Sh. & Sw., gr. 4-8 (gm. .24-.5] D., gr. 1-2 (gm. .06-.12).

Cantharides, Tincture of.—H., dr. 2-4 (cc. 8.-15.). D., m. 2-15 (cc. .12-1.).

Capsicum.—H., gr. 20-60 (gm. 1.3-4.). C., dr. 1-2 (gm. 4.-8.). D., gr. 1-8 (gm. .06-.48).

Capsicum, Fluidextract of.—Dose same as Capsicum.

Capsicum, Oleoresin of.—H., m. 10-30 (cc. .6-2.). C., dr. ½-1 (cc. 2.-4.). D., m. ¼-1 (cc. .015-.06).

Capsicum, Tincture of.—H., dr. 2-4 (cc. 8.-15.). C., oz. ½-1 (cc. 15.-30.). D., m. 5-60 (cc. .3-4.).

Carbon Bisulphide.—H., dr. 2-4 (cc. 8.-15.).

Cardamon.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-3 (gm. 8.-12.). D., gr. 10-30 (gm. .6-2.).

CARDAMON, Fluidextract of.—Dose same. (Non-official.)

CARDAMON, Compound Tincture of.—D., dr. 1-2 (cc. 4.-8.).

CARDAMON, Tincture of.—D., dr. 1-2 (cc. 4.-8.).

CASCARA SAGRADA.—D., gr. 5-30 (gm. .3-2.).

CASCARA SAGRADA, Fluidextract of.—D., m. 5-30 (cc. .3-2.).

CASCARA SAGRADA (Solid) Extract of.—D., gr. 2-8 (gm. .12-.5).

CASCABILLA.—H. & C., oz. ½-1 (gm. 15.-30.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 10-30 (gm. .6-2.).

CASTOR OIL.—H. & C., pt. 1 (cc. 500.). Sh. & Sw., oz. 2-4 (cc. 60.-120.). D., dr. 1-2 (cc. 4.-8.). Fowl, dr. 1 (cc. 4.).

CATECHU.—H., oz. ½-1 (gm. 15.-30.). C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 5-30 (gm. .3-2.).

CATECHU, Fluidextract of (non-official).—Dose same as Catechu.

CATECHU, Tincture of.—H. & C., oz. 1-2 (cc. 30.-60.). Foals, Calves and Sheep, oz. ½-1 (cc. 15.-30.). D., dr. ½-2 (cc. 2.-8.).

CERIUM OXALATE.—D., gr. 3-5 (gm. .2-.3).

CHALK, Compound Powder of.—D., gr. 10-60 (gm. .6-4.).

CHALK MIXTURE.—D., oz. 1-2 (cc. 30.-60.).

CHALK, PREPARED.—H., oz. 1-2 (gm. 30.-60.). C., oz. 2-4 (gm. 60.-120.). Sh. & Sw., dr. 2-4 (gm. 8.-15.). D., gr. 10-60 (gm. .6-4.).

CHARCOAL (Wood, and animal, purified).—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-4 (gm. 8.-15.). D., gr. 20-60 (gm. 1.3-4.).

CHLORAL.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 5-20 (gm. .3-1.3).

CHLORETONE.—D., gr. 5-10 (gm. 0.3-0.6.).

CHLOROFORM.—H. & C., dr. 1-2 (cc. 4.-8.). Sh. & Sw., m. 20-30 (cc. 1.3-2.). D., m. 2-20 (cc. .12-1.3).

CHLOROFORM, Spirit of.—H. & C., oz. 1-2 (30.-60.). Sh. & Sw., dr. 2-4 (cc. 8.-15.). D., dr. ½-1 (cc. 2.-4.).

CINCHONA BARK.—H., dr. 2-4 (gm. 8.-15.). C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 1-4 (gm. 4.-15.). D., gr. 10-60 (gm. .6-4.).

CINCHONA, Compound Tincture of.—H., oz. 2-4 (cc. 60.-120.). D., dr. ½-4 (cc. 2.-15.).

CINCHONA, Extract of.—H., dr. 1-2 (gm. 4.-8.). D., gr. 5-30 (gm. .3-2.).

CINCHONA, Fluidextract of.—H., dr. 2-4 (cc. 8.-15.). C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., dr. 1-4 (cc. 4.-15.). D., gr. 10-60 (cc. .6-4.).

CINCHONINE SULPHATE, Tonic Dose.—H., gr. 20-60 (gm. 1.3-4.). C., dr. ¾-1½ (gm. 3.-6.). Sh. & Sw., gr. 6-15 (gm. .36-1.). D., gr. 1½-2½ (.1-.15).

Cinchonine Sulphate, Antipyretic Dose.—H., dr. 2½-5 (gm. 10.-20.). Sh. & Sw., gr. 40-50 (gm. 2.6-3.3). D., gr. 7-15 (gm. .5-1.).

Cinchonidine Sulphate.—Dose same as Cinchonine Sulphate.

Cocaine Hydrochloride.—H., gr. 5-10 (gm. .3-.6). D., gr. ⅛-¾ (gm. .008-.045).

Cod Liver Oil.—H., oz. 2-4 (cc. 60.-120.). Sh. & Sw., oz. ½-1 (cc. 15.-30.). D., dr. 1-3 (cc. 4.-12.).

Codeine.—D., gr. ¼-2 (gm. .015-.12).

Colchicine.—H. & C., gr. ⅛-½ (gm. .01-.03). D., gr. 1/120-1/60 (gm. .0005-.0012).

Colchicum Corm.—H. & C., dr. ½-2 (gm. 2.-8.). Sh., gr. 10-20 (gm. .6-1.3). Sw. & D., gr. 2-8 (gm. .12-.5).

Colchicum Corm, Fluidextract of.—Dose same as Colchicum.

Colchicum Corm, Tincture of.—H. & C., dr. 3-8 (cc. 12.-30.). D., m. 10-30 (cc. .6-2.).

Colchicum Corm, Wine of.—H. & C., dr. 3-8 (cc. 12.-30.). D., m. 10-30 (cc. .6-2.).

Collargol (Colloidal Silver).—See p. 170.

Colocynth.—D., gr. 3-8 (gm. .2-.5).

Colocynthin.—H., dr. ½-1 (gm. 2.-4.). D., gr. ¼-1 (gm. .015-.06).

Coniine Hydrobromide.—H. & C., gr. ¾-1½ (gm. .045-.1). Sh. & Sw., gr. ⅛-⅜ (gm. .012-.024). D., gr. 1/30-1/12 (gm. .002-.005).

Conium.—H. & C., dr. 1-2 (gm.-4.-8.). Sh. & Sw., gr. 10-20 (gm. .6-1.3). D., gr. 2-5 (gm. .12-.3).

Conium, Fluidextract of.—Dose same as Conium.

Conium, Extract of.—H. & C., gr. 12-24 (gm. .72-1.5). Sh. & Sw., gr. 2-4 (gm. .12-.24). D., gr. ¼-1 (gm. .015-.06).

Convallaria, Fluidextract of.—H. & C., dr. 1-2 (cc. 4.-8.). D., m. 5-10 (cc. .3-.6).

Copper Sulphate.—H. & C., dr. 2-4 (gm. 8.-15.). Sh. & Sw., gr. 20-40 (gm. 1.3-2.6). D., gr. 1-2 (gm. .06-.12). Emetic—D., gr. 6-20 (gm. .36-1.3).

Corrosive Sublimate.—(See Mercury.)

Cotton Root Bark.—(See Gossypium.)

Creosote.—H., m. 15-30 (cc. 1.-2.). C., dr. ½-1 (cc. 2.-4.). Sh. & Sw., m. 5.-15 (cc. .3-1.). D., m. ½-2 (cc. .03-.12).

Creolin.—H. & C., dr. 1-2 (cc. 4.-8.). D., m. 1-5 (cc. .06-.3). Single dose as anthelmintic. H., oz. ½-1 (cc. 15.-30.).

Croton Oil.—H., m. 15-30 (cc. 1.-2.). C., dr. ½-1 (cc. 2.-4.). Sh. & Sw., m. 5-10 (cc. .3-.6). D., m. ½-3 (cc. .03-.2).

Digitalein.—H., gr. ⅛-¼ (gm. .008-.015). D., gr. 1/100 (gm. .0006).

DIGITALIN.—H., gr. $\frac{1}{8}$-$\frac{1}{4}$ (.008-.015). D., gr. $\frac{1}{200}$-$\frac{1}{100}$ (.0003-.0006).

DIGITALINUM PURUM, German.—H., gr. ss.-i. (.03-.06). D., gr. $\frac{1}{60}$-$\frac{1}{30}$ (.001-.002).

DIGITALIS.—H., gr. 10-60 (gm. .6-4.). C., dr. $\frac{1}{2}$-$1\frac{1}{2}$ (gm. 2.-6.). Sh. & Sw., gr. 5-15 (gm. .3-1.). D., gr. $\frac{1}{2}$-3 (gm. .03-.2).

DIGITALIS, Fluidextract of.—Dose same as Digitalis.

DIGITALIS, Extract of.—H., gr. 5-10 (gm. .3-.6). D., gr. $\frac{1}{8}$-$\frac{1}{2}$ (gm. .008-.03).

DIGITALIS, Infusion of.—H. & C., oz. 2-6 (cc. 60.-180.). Sh. & Sw., oz. $\frac{1}{2}$-1 (cc. 15.-30.). D., dr. 1-4 (cc. 4.-15.).

DIGITALIS, Tincture of.—H. & C., dr. 2-4 (cc. 8.-15.). Sh. & Sw., dr. $\frac{1}{2}$-$1\frac{1}{2}$ (cc. 2.-6.). D., m. 5-30 (cc. .3-2.).

DIGITALONE, subcut.—H., dr. 2-4 (c.c. 8.-15.). D., m. 5-20 (c.c. 0.3-1.3).

DIGITOXIN.—H., gr. $\frac{1}{8}$-$\frac{1}{4}$ (.008-.015). D., gr. $\frac{1}{250}$-$\frac{1}{50}$ (.00025-.00125).

DOVER'S POWDER.—H., oz. $\frac{1}{2}$-1 (gm. 15.-30.). D., gr. 5-10 (gm. .3-.6).

DOVER'S POWDER, Liquid.—H., oz. $\frac{1}{2}$-1 (cc. 15.-30.). D., m. 5-10 (cc. .3-.6).

ELATERIN.—D., gr. $\frac{1}{20}$-$\frac{1}{12}$ (gm. .003-.005).

ERGOT.—H. & C., oz. $\frac{1}{2}$-1 (gm. 15.-30.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., dr. $\frac{1}{2}$-1 (gm. 2.-4.).

ERGOT, Fluidextract of.—Dose same as Ergot.

ERGOT, Extract of (Ergotin).—H. & C., gr. 20-60 (gm. 1.3-4.). D., gr. 2-10 (gm. .12-.6).

ERGOT, Tincture of.—H. & C., oz. $\frac{1}{2}$-2 (cc. 15.-60.). Sh. & Sw., dr. 1-4 (cc. 4.-15.). D., dr. $\frac{1}{2}$-2 (cc. 2.-8.).

ESERINE.—(See Physostigmine.)

ETHER.—H. & C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., dr. 2-4 (cc. 8.-15.). D., m. 10-60 (cc. .6-4.).

ETHER, Spirit of, and Compound Spirit of.—H. & C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., dr. 2-4 (cc. 8.-15.). D., m. 10-60 (cc. .6-4.).

ETHER, NITROUS, Spirit of (Sweet Spirit of Nitre).—H. & C., oz. 1-4 (cc. 30.-120.). Sh. & Sw., dr. 2-4 (cc. 8.-15.). D., m. 10-60 (cc. .6-4.).

EUCALYPTUS, Fluidextract of.—H., oz. 2-3 (cc. 60.-90.). D., dr. $\frac{1}{2}$-2 (cc. 2.-8.).

EUCALYPTUS, Oil of.—H., dr. 2-4 (cc. 8.-15.). D., m. 5-20 (cc. .3-1.3).

EUCALYPTOL.—Dose same as Oil of Eucalyptus.

FENNEL.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-3 (gm. 8.-12.). D., gr. 10-20 (gm. .6-1.3).

FEL BOVIS.—(See Oxgall.)

FENUGREEK.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-3 (gm. 8.-12.). D., gr. 10-30 (gm. .6-2.).

FIBROLYSIN.—H., 11.5 c.c. subcut.

FRANGULA, Fluidextract of.—D., dr. ½-1 (cc. 2.-4.).

GAMBOGE.—H., oz. ½-1 (gm. 15.-30.). C., oz. 1-1½ (gm. 30.-45.). Sh. & Sw., gr. 20-60 (gm. 1.3-4.). D., gr. 5-10 (gm. .3-.6).

GAULTHERIA, Oil of.—H. & C., dr. 2-oz. 1 (cc. 8.-30.). Sh. & Sw., dr. ½-2 (cc. 2.-8.). D., m. 5-15 (cc. .3-1.).

GELSEMINE.—H., gr. ¼-½ (gm. .015-.03). D., gr. 1/60-1/20 (gm. .001-.003).

GELSEMIUM.—H., dr. 1-2 (gm. 4.-8.). D., gr. 5-10 (gm. .3-.6).

GELSEMIUM, Fluidextract of.—Dose same as Gelsemium.

GELSEMIUM, Tincture of.—H., oz. ½-2 (cc. 15.-60.). D., m. 15-60 (cc. 1.-4.).

GENTIAN.—H., oz. ½-1 (gm. 15.-30.). C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 5-30 (gm. .3-2.).

GENTIAN, Fluidextract of.—Dose same as Gentian.

GENTIAN, Compound Tincture of.—H. & C., oz. 1-4 (cc. 30.-120.). D., dr. 1-4 (cc. 4.-15.).

GINGER.—H., dr. 2-oz. 1 (gm. 8.-30.). C., oz. 1-4 (gm. 30.-120.). Sh. & Sw., dr. 1-2 (gm. 4-8). D., gr. 5-15 (gm. .3-1.).

GINGER, Fluidextract of.—Dose same as Ginger.

GINGER, Oleoresin of.—One-fifth dose of Ginger.

GLYCERIN.—H. & C., oz. 1 (cc. 30.). D., dr. ½-1 (cc. 2.-4.).

GLYCEROPHOSPHATES, Lime and Iron.—H., dr. 3 (gm. 12.). D., gr. 5-15 (gm. 0.3-1.).

GLYCYRRHIZA.—See licorice.

GOSSYPIUM ROOT, Fluidextract of Bark of.—H. & C., oz. ½-1 (cc. 15.-30.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., dr. ½-1 (cc. 2.-4.).

GRANATUM (Pomegranate).—D., dr. ½-1½ (gm. 2.-6.).

GRANATUM, Fluidextract of.—Dose same as granatum.

GRANATI RADICIS CORTEX, Fluidextract of.—D., dr. ½-2 (cc. 2.-8.).

HÆMATOXYLON, Extract of.—H. & C., dr. ½-4 (gm. 2.-15.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-15 (gm. .3-1.).

HÆMATOXYLON, Fluidextract of.—H. & C., oz. ½-1½ (cc. 15.-45.). Sh. & Sw., dr. 1½-3 (cc. 6.-12.). D., m. 15-45 (cc. 1.-3.).

HAMAMELIS, Fluidextract of.—H. & C., oz. 1-2 (cc. 30.-60.). D., dr. ½-2 (cc. 2.-8.).

HAMAMELIS, Water of.—Same doses as fluidextract.

HYDRASTIN.—H., gr. 15-30 (gm. 1.-2.). D., gr. 3-5 (gm. .2-.3).

HYDRASTINE HYDROCHLORATE.—H., gr. 1-2 (gm. .06-.12). D., gr. 1/12-1/6 (gm. .005-.01).

Hydrastis, Fluidextract of.—H. & C., dr. 2-oz. 1 (cc. 8.-30.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 5-60 (cc. .3-4.).

Hydrastis, Glycerite of.—Dose same as Fluid Extract.

Hydrastis, Tincture of.—H., oz. 1-2 (cc. 30.-60.). D., dr. ½-2 (cc. 2.-8.).

Hyoscine Hydrobromide.—H., gr. $\frac{1}{6}$-¼ (gm. .01-.015). D., gr. $\frac{1}{150}$-$\frac{1}{100}$ (gm. .0004-.0006).

Hyoscyamine Hydrobromide and Sulphate.—H., gr. 1-2 (gm. .06-.12). D., gr. $\frac{1}{60}$-$\frac{1}{30}$ (gm. .001-.002).

Hyoscyamus.—H. & C., oz. ½-1 (gm. 15.-30.). D., gr. 5-15 (gm. .3-1.).

Hyoscyamus, Fluidextract of.—Dose same as Hyoscyamus.

Hyoscyamus, Extract of.—H. & C., gr. 20-60 (gm. 1.3-4.). D., gr. ½-2 (gm. .03-.12).

Hyoscyamus, Tincture of.—D., dr. 1-2 (cc. 4.-8.).

Hyoscyamus, Succus of.—D., dr. 1-2 (cc. 4.-8.).

Hypophosphites, Compound Syrup of.—D., dr. 1 (cc. 4.).

Influenza Antitoxin.—H., 30 to 90 c.c.

Iodine.—H. & C., dr. ½-1 (gm. 2.-4.). Sh. & Sw., gr. 10-20 (gm. .6-1.3). D., gr. 2-5 (gm. .12-.3).

Iodine, Compound Solution of.—H., dr. 2-4 (cc. 8.-15.). D., m. 2-10 (cc. .12-.6).

Iodine, Tincture of.—H., dr. 2-4 (cc. 8.-15.). D., m. 2-10 (cc. .12-.6).

Ipecac.—H., dr. 1-2 (gm. 4.-8.). C., dr. 2-4 (gm. .8-15.). Sh., dr. ½-1 (gm. 2.-4.). D., gr. ½-2 (gm. .03-.12). Emetic—D. & Sw., gr. 15-30 (gm. 1.-2.). Cats, gr. 5-12 (gm. .13-.72).

Ipecac, Fluidextract of.—Dose same as Ipecac.

Ipecac, Syrup of.—D., Expectorant, m. 15-60 (cc. 1.-4.).

Ipecac, Wine of.—D., Expectorant, m. 15-60 (cc. 1.-4.).

Iron and Ammonium Citrate.—D., gr. 5-10 (gm. .3-.6).

Iron, Carbonate, Saccharated.—H., dr. 1-2 (gm. 4.-8.). C., dr. 2-4 (gm. 8.-15.). Sh. & Sw., gr. 20-30 (gm. 1.3-2.). D., gr. 1-5 (gm. .06-.3).

Iron, Chloride, Solution of.—H. & C., dr. 2-4 (cc. 8.-15.). Sh. & Sw., m. 10-20 (cc. .6-1.3). D., m. 2-10 (.12-.6).

Iron, Chloride, Tincture of.—H. & C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., m. 20-30 (cc. 1.3-2.). D., m. 5-60 (cc. .3-4.).

Iron, Iodide, Syrup of.—D., m. 5-10 (cc. .3-.6.).

Iron, (and) Quinine Citrate.—D., gr. 5-10 (gm. .3-.6).

Iron, Reduced.—H., dr. 1-2 (gm. 4.-8.). C., dr. 2-4 (gm. 8-15). Sh. & Sw., gr. 20-30 (gm. 1.3-2.). D., gr. 1-5 (gm. .06-.3).

Iron, (and) Strychnine Citrate.—D., gr. 1-2 (gm. .06-.12).

IRON, Sulphate and Dried Sulphate.—H. & C., dr. 1-2 (gm. 4.-8.). Sh. & Sw., gr. 20-30 (gm. 1.3-2.). D., gr. 1-5 (gm. .06-.3).

JABORANDI.—H. & C., dr. 2-4 (gm. 8.-15.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-60 (gm. .3-4.).

JABORANDI, Fluidextract of.—Dose same as Jaborandi.

JALAP.—Sw., dr. 2-4 (gm. 8.-15.). D., dr. 1-2 (gm. 4.-8.). Cats, dr. ½-1 (gm. 2.-4.).

JALAP, Fluidextract of.—Dose same as Jalap.

JALAP, Resin of.—Sw., dr. ½-1 (gm. 2.-4.). D., gr. 15-30 (gm. 1.-2.). Cats, gr. 7-15 (gm. .5-1.).

JUNIPER, Compound Spirit of.—H. & C., oz. 2-4 (cc. 60.-120.). D., dr. 1-4 (cc. 4.-15.).

JUNIPER, Oil of.—H. & C., dr. 1-2 (cc. 4.-8.). D., m. 2-10 (cc. .12-.6).

KAMALA.—H., oz. 1 (gm. 30.). D., dr. ½-2 (gm. 2.-8.).

KINO.—H., oz. ½-1 (gm. 15.-30.). C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 5-30 (gm. .3-2.).

KINO, Fluidextract of.—Dose same as Kino.

KINO, Tincture of.—H. & C., oz. 1-2 (cc. 30.-60.). Foals, Calves and Sheep, oz. ½-1 (cc. 15.-30.). D., dr. ½-2 (cc. 2.-8.).

KOUSSIN.—D., gr. 5-40 (gm. .3-2.6).

KOUSSO.—Small dogs, dr. ½-1 (gm. 2.-4). Large dogs, dr. 2-4 (gm. 8.-15.).

KOUSSO, Fluidextract of.—Dose same as Kousso.

KRAMERIA.—H., oz. ½-1 (gm. 15.-30.). C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 1-2 (gm. 4.-8.). D., gr. 5-30 (gm. .3-2.).

KRAMERIA, Fluidextract of.—Dose same as Krameria.

KRAMERIA, Extract of.—H. & C., dr. 2-3 (gm. 8.-12.). Sh. & Sw., gr. 20-40 (gm. 1.3-2.6). D., gr. 5-10 (gm. .3-.6).

KRAMERIA, Tincture of.—H. & C., oz. 1-2 (cc. 30.-60.). Foals, Calves and Sheep, oz. ½-1 (cc. 15.-30.). D., dr. ½-2 (cc. 2.-8.).

LEAD ACETATE.—H. & C., dr. 1 (gm. 4.). Sh. & Sw., gr. 15-20 (gm. 1.-1.3). D., gr. 1-2 (gm. .06-.12).

LICORICE.—Ad lib.

LICORICE, Fluidextract of.—Ad lib.

LICORICE, Extract of.—Ad lib.

LICORICE, Compound Powder of.—D., dr. 1-2 (gm. 4.-8.).

LIME, Solution of (Lime Water).—H. & C., oz. 4-6 (cc. 120.-180.). Calves and Foals, oz. 2 (cc. 60.). D., dr. 1-8 (cc. 4.-30.).

LINSEED OIL.—H., pt. ½-1 (cc. 250.-500). C., pt. 1-2 (cc. 500.-1000.). Sh. & Sw., oz. 6-12 (cc. 180.-360.). Dogs and Cats, oz. ½-2 (cc. 15.-60.).

Lithium Carbonate.—D., gr. 3-10 (gm. .2-.6).

Lithium Citrate.—D., gr. 5-20 (gm. .3-1.3).

Magnesia.—Foals and Calves, dr. 1-2 (gm. 4.-8.). D., gr. 5-60 (gm. .3-4.).

Magnesium Carbonate.—Dose same as Magnesia.

Magnesium Sulphate.—H. (laxative), oz. 2-4 (gm. 60.-120.). C. (purgative), lb. 1-2 (gm. 500.-1000.); (laxative), oz. 3-4 (gm. 90.-120.). Calves, dr. 2-3 (gm. 8.-12.). Sh., oz. 4-6 (gm. 120.-180.). D., dr. 1-4 (gm. 4.-15.).

Male Fern, Oleoresin and Fluid Extract of.—H. & C., dr. 3-6 (cc. 12.-24.). Sh. & Sw., dr. 1-2 (cc. 4.-8.). D., m. 15-60 (cc. 1.-4.).

Menthol.—D., gr. 2 (gm. .12).

Mercury with Chalk.—Foals and Calves, gr. 10-15 (gm. .6-1.). D., gr. 1-10 (gm. .06-.6).

Mercury, Corrosive Chloride of.—H. & C., gr. 5-8 (gm. .3-.5). Sh. & Sw., gr. 2 (gm. .12). D., gr. $\frac{1}{30}$-$\frac{1}{8}$ (gm. .002-.008).

Mercury, Iodide of (red).—Dose same as Corrosive Chloride.

Mercury, Mass of (Blue Pill).—D., gr. 1-10 (gm. .06-.6).

Mercury, Mild Chloride of.—H., dr. $\frac{1}{2}$-1 (gm. 2.-4.). C., dr. 5-6 (gm. 20.-24.). D., gr. $\frac{1}{10}$-$\frac{1}{2}$ (gm. .006-.03), in divided doses; gr. 3-5 (gm. .2-.3), in single doses.

Methyl Salicylate.—H., dr. 2-8 (cc. 8.-30). D., m. 5-15 (cc. .3-1.).

Morphine and its Salts.—H. & C., gr. 3-10 (gm. .2-.6). Sh., gr. $\frac{1}{2}$-2 (gm. .03-.12). Sw., gr. $\frac{1}{10}$-$\frac{1}{2}$ (gm. .006-.03). D., gr. $\frac{1}{8}$-$\frac{1}{2}$ (gm. .008-.03). Subcutaneously—H., gr. 3-4 (gm. .2-.24). D., gr. $\frac{1}{8}$-$\frac{1}{2}$ (gm. .008-.03).

Morrhuol.—D., gr. 1-5 (gm. .06-.3).

Mustard.—H. & C., oz. $\frac{1}{2}$-1 (gm. 15.-30.). Sh. & Sw., dr. $\frac{1}{2}$-2 (gm. 2.-8.). D., gr. 10-15 (gm. .6-1.). Emetic—D., oz. $\frac{1}{2}$ (gm. 15.).

Myrrh, Tincture of.—H. & C., ℥ i.-ii. (30.-60.). Sh. & Sw., ʒ iii.-vi. (12.-24.). D., ʒ ss.-i. (2.-4.).

Naphthalin.—H., dr. 2-4 (gm. 8.-15.). D., gr. 1-20 (gm. .06-1.3).

Naphtol.—H., dr. 2-3 (gm. 8.-12.). D., gr. 1-10 (gm. .06-.6).

Nicotine.—H. & C., gr. $\frac{1}{60}$-$\frac{1}{20}$ (gm. .001-.003).

Nitroglycerin (1 per cent. solution).—H. & C., dr. $\frac{1}{2}$-1 (cc. 2.-4.). D., m. 1-2 (cc. .06-.12).

Nux Vomica.—H. & C., dr. 1-2 (gm. 4.-8.). Sh., gr. 20-40 (gm. 1.3-2.6). Sw., gr. 10-20 (gm. .6-1.3). D., gr. 1-2 (gm. .06-.12).

Nux Vomica, Extract of.—H. & C., gr. 2-15 (gm. .12-1.) Sh., gr. 2$\frac{1}{2}$-5 (gm. .15-.3). Sw., gr. 1-2 (gm. .06-.12). D., gr. $\frac{1}{8}$-$\frac{1}{4}$ (gm. .008-.015).

Nux Vomica, Fluidextract of.—Dose same as Nux Vomica.

Nux Vomica, Tincture of.—D., m. 5-10 (cc. .3-.6).

Olive Oil.—H. & C., pt. 1-2 (cc. 500.-1000.). D., oz. 2-4 (cc. 60.-120.).

Opium, Camphorated Tincture of (Paregoric).—D., dr. 1-4 (cc. 4.-15.).

Opium, Extract of.—H., dr. ½-1 (gm. 2.-4.). C., dr. 1-2 (gm. 4.-8.). Sh., gr. 5-10 (gm. .3-.6). Sw., gr. 2-10 (gm. .12-.6). D., gr. ⅛-½ (gm. .01-.03).

Opium, Powder.—H., dr. 1-2 (gm. 4.-8.). C., dr. 2-4 (gm. 8.-15.). Sh., gr. 10-20 (gm. .6-1.3). Sw., gr. 5-20 (gm. .3-1.3). D., gr. ½-3 (gm. .03-.2).

Opium, Tincture of.—H., oz. 1-2 (cc. 30.-60.). C., oz. 2-3 (cc. 60.-90.). Sh. & Sw., dr. 2-6 (cc. 8.-24.). D., m. 3-30 (cc. .2-2.).

Opium, Wine of.—Dose same as Tincture.

Oxgall.—D., gr. 5-15 (gm. .3-1.).

Pancreatin.—D., gr. 5-15 (gm. .3-1.).

Papain.—Foals, Calves and Dogs, gr. 2-10 (gm. .12-.6).

Pelletierine Tannate.—D., gr. 2-5 (gm. .12-.3).

Peppermint, Oil of.—H. & C., m. 15-30 (cc. 1.-2.). D., m. 1-5 (cc. .06-.3).

Peppermint, Spirit of.—H. & C., dr. 2-4 (cc. 8.-15.). D., m. 15-30 (cc. 1.-2.).

Pepsin.—Dogs, Foals and Calves, gr. 10-60 (gm. .6-4.).

Phenacetin.—H., dr. 2-3 (gm. 8.-12.). D., gr. 5-10 (gm. .3-.6).

Phenolphthalein.—H., dr. 1-1½ (gm. 4.-6.). D., gr. 2-10 (0.12-0.6). Cats & Puppies, gr. ½-2 (gm. 0.03-0.12).

Phenol.—See Acid Carbolic.

Phosphorated Oil.—H., dr. 2-3 (cc. 8.-12.). D., m. 1-5 (cc. .06-.3).

Phosphorus.—H., gr. 1-2 (gm. .06-.12). C., gr. 2-3 (gm. .12-.2). Sh., Sw. & D., gr. 1/100-1/20 (gm. .0006-.003).

Phosphorus, Spirit of.—D., m. 7-20 (cc. .5-1.3).

Physostigma.—H., gr. 15-30 (gm. 1.-2.). D., gr. ¼-1 (gm. .015-.06).

Physostigma, Fluidextract of.—Dose same as Physostigma.

Physostigmine Sulphate and Salicylate.—H. & C. By the mouth, gr. lss.-iii. (.09-.18). D., gr. 1/60-1/10 (.001-.006). H. Subcut., gr. l.-lss. (.06-.09). Intratracheally, gr. ss. (.03). Foals and Calves, subcut., gr. 1/12-1/6 (.005-.01). D. subcut., gr. 1/100-1/30 (.0006-.002).

Pilocarpine and its Salts.—(Subcut.) H. (purgative), gr. 2-5 (gm. .12-.3). C. (purgative), gr. 5-10 (gm. .3-.6). H. (diaphoretic; dangerous), gr. 6-12 (gm. .36-.72). Sh., gr. 1 (gm. .06). D., gr. 1/10-1/3 (gm. .006-.02).

Pilocarpus.—H. & C., dr. 2-4 (gm. 8.-15.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-60 (gm. .3-4.).

Pilocarpus, Fluidextract of.—Dose same as Pilocarpus.

Podophyllin.—H. & C., dr. 1-2 (gm. 4.-8.). D., gr. 1-2 (gm. .06-.12).

Pomegranate.—See Granatum.

Potassium Acetate.—H. & C., oz. ½-1 (gm. 15.-30.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-20 (gm. .3-1.3).

Potassium Bicarbonate.—Dose same as Acetate.

Potassium Bitartrate.—H. & C., oz. ½-1 (gm. 15.-30.). Sh. & Sw., oz. ½ (gm. 15.). D., dr. ½-1 (gm. 2.-4.).

Potassium Bromide.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-4 (gm. 8.-15. D., gr. 5-60 (gm. .3-4.).

Potassium Carbonate.—H. & C., oz. ½-1 (gm. 15.-30.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-20 (gm. .3-1.3).

Potassium Chlorate.—Dose same as Carbonate.

Potassium Citrate.—Dose same as Carbonate.

Potassium Hydroxide, Solution of.—H. & C., oz. ½-1 (cc. 15.-30.). Sh. & Sw., dr. ½-1 (cc. 2.-4.). D., m. 5-20 (cc. .3-1.3).

Potassium Iodide.—H., 3 ii.-iv. (8.-15). C., 3 vi. (24). Sh. & Sw., gr. xv.-xxx. (1.-2.). D., gr. ii. x. (.12-.6.).

Potassium Nitrate.—Dose same as Carbonate.

Quassia, Extract of.—H., dr. 1-2 (gm. 4.-8.). D., gr. ½-3 (gm. .03-.2).

Quassia, Fluidextract of.—H. & C., oz. 1-2 (cc. 30.-60.). Sh. & Sw., dr. 2-4 (cc. 8.-15.). D., m. 15-60 (cc. 1.-4.).

Quassia, Tincture of.—H. & C. oz. 2-4 (cc. 60.-120.). D., dr. ½-2 (cc. 2.-8.).

Quassiin.—D., gr. ⅛-⅓ (gm. .008-.02).

Quercus Alba.—H., oz. ½-1 (gm. 15.-30.). C., oz. 1-2 (gm. 30.-60.). Sh. and Sw., dr. 1-2 (gm. 4.-8.). D., gr. 10-30 (gm. .6-2.).

Quercus Alba, Fluidextract of.—Dose same as Quercus Alba.

Quinidine.—Tonic dose—H. gr. 20-60 (gm. 1.3-4.). C., dr. ¾-1½ (gm. 3.-6.). Sh. & Sw., gr. 6-15 (gm. .36-1.). D., gr. 1½-2½ (gm. .1-.15). Antipyretic dose—H., dr. 2½-5 (gm. 10.-20.). Sh. & Sw., gr. 20-40 (gm. 1.3-2.6). D., gr. 7-15 (gm. .5-1.).

Quinine and its Salts.—Tonic dose—H., gr. 15-60 (gm. 1.-4.) C., dr. ½-1½ (gm. 2.-6.). Sh. & Sw., gr. 5-10 (gm. .3-.6). Dogs and Cats, gr. 1-2 (gm. .06-.12). Antipyretic dose—H. & C., dr. 2-4 (gm. 8.-15.). Sh. & Sw., gr. 20-40 (gm. 1.3-2.6). Dogs and Cats, gr. 5-10 (gm. .3-.6).

Quinoidin.—Dose three or four times that of Quinine.

Resorcin.—H., dr. 4-6 (gm. 15.-24.). Foals and Calves, dr. ½-1 (gm. 2.-4.). D., gr. 2-5 (gm. .12-.3).

Rhamnus Catharticus, Syrup of.—D., oz. 1-2 (cc. 30.-60.). Cats, oz. ½-1 (cc. 15.-30.).

Rhamnus Catharticus, Fluidextract of.—D., dr. ½-1 (cc. 2.-4.).

RHUBARB.—Stomachic—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 1 (gm. 4.). D., gr. 5-10 (gm. .3-.6). Purgative—Foals, Calves and Dogs, dr. 1-2 (gm. 4.-8.). Fowl, gr. v.-vii. in pill.

RHUBARB, Fluidextract of.—Dose same as Rhubarb.

RHUBARB, Compound Powder of.—Foals and Calves, oz. ½-1 (gm. 15.-30.).

SABINA, Fluidextract of.—H., oz. 1-2 (cc. 30.-60.). D., m. 5-15 (cc. .3-1.).

SABINA, Oil of.—H. & C., dr. 2-4 (cc. 8.-15.). D., m. 1-5 (cc. .06-.3).

SALICIN.—H. & C., dr. 2-8 (gm. 8.-30.). Sh., dr. 1-4 (gm. 4.-15.). Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-30 (gm. .3-2.).

SALOL.—H., dr. 3-6 (gm. 12.-24.). D., gr. 5-10 (gm. 0.3-0.6).

SANTONIN.—H., dr. ¼-4 (1.-15.). D., gr. 1-3 (.06-.18). Puppies, gr. ¼-½ (.015-.03).

SAVIN.—See Sabina.

SCAMMONY.—D., dr. 1-2 (gm. 4.-8.). Cats, dr. ½-1 (gm. 2.-4.).

SCAMMONY, Resin of.—D., dr. ½-1 (gm. 2.-4.). Cats, gr. 15-30 (gm. 1.-2.).

SENNA.—H. & C., oz. 4-5 (gm. 120.-150.). Sh. & Sw., oz. 1-2 (gm. 30.-60.). D., dr. 1-4 (gm. 4.-15.). Fowl, gr. xv.-xx. in pill.

SENNA, Fluidextract of.—Dose same as Senna.

SENNA, Syrup of.—D., dr. 1-4 (4.-15.).

SERUM, Antistreptococcus.—See p. 661.

SILVER NITRATE.—H. & C., gr. 5-10 (gm. .3-.6). Sh. & Sw., gr. 1-2 (gm. .06-.12). D., gr. ⅛-½ (gm. .008-.03).

SODIUM BICARBONATE.—H. & C., oz. ½-2 (gm. 15.-60.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-30 (gm. .3-2.).

SODIUM CACODYLATE.—H., gr. 8-30 (gm. 0.5-2.). D., gr. ¾-1½ (gm. 0.05-0.1) subcut.

SODIUM CARBONATE.—H. & C., dr. 2-6 (gm. 8.-24.). Sh. & Sw., gr. 20-40 (gm. 1.3-2.6). D., gr. 5-20 (gm. .3-1.3).

SODIUM CHLORIDE.—Purgative—Cattle, lb. ½-1 (gm. 250.-500.). Sh., oz. 1-2 (gm. 30.-60.).

SODIUM BROMIDE.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-4 (gm. 8.-15.). D., gr. 5-60 (.3-4.).

SODIUM HYDROXIDE, Solution of.—H. & C., oz. ½-1 (cc. 15.-30.). Sh. & Sw., dr. ½-1 (cc. 2.-4.). D., m. 5-20 (cc. .3-1-3).

SODIUM PHOSPHATE.—C., lb. 1-1½ (gm. 500.-750.). H. & Sh., oz. 2-4 (gm. 60.-120.). D., dr. 1-2 (gm. 4.-8.).

SODIUM SALICYLATE.—H. & C., dr. 2-8 (gm. 8.-30.). Sh., dr. 1-4 (4.-15.). Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-30 (gm. .3-2.).

SODIUM SULPHATE.—C., lb. 1-1½ (gm. 500.-750.). H., oz. 2-4 (gm. 60.-120.). Sh., oz. 2-4 (g. 60.-120.). D., dr. 1-4 (gm. 4.-15.).

Sodium Sulphite, Bisulphite and Thiosulphate.—H. & C., oz. 1 (gm. 30.). Sh. & Sw., dr. ½-1 (gm. 2.-4.). D., gr. 5-30 (gm. .3-2.).

Squill.—H., dr. 1-2 (gm. 4.-8.). C., dr. 2-4 (gm. 8.-15.). Sh., gr. 15-30 (gm. 1.-2.). D., gr. 1-5 (gm. .06-.3).

Squill, Fluidextract of.—Dose same as Squill.

Squill, Tincture of.—H., dr. 6-12 (cc. 24.-48.). C., oz. 1½-3 (cc. 45.-90.). Sh., dr. 1½-3 (cc. 6.-12.). D., m. 5-30 (cc. .3-2.).

Squill, Syrup of.—H., oz. ½ (cc. 15.). D., dr. ½-1 (cc. 2.-4.).

Squill, Compound Syrup of.—D., m. 5-30 (cc. .3-2.).

Strophanthus, Tincture of.—H. & C., dr. 1-4 (cc. 4.-15.). D., m. 2-10 (cc. .12-.6).

Strophanthin.—H., gr. ⅛-½ (gm. .012-.03). D., gr. 1/200 (0.0003).

Strychnine and its Salts.—H., gr. ½-2 (gm. .03-.12). C., gr. 2-3 (gm. .12-.2). Subcutaneously. H. & C., gr. ½ to 1. Sh., gr. ¼-1 (gm. .015-.06). D., gr. 1/120-1/60 (gm. .0005-.001).

Sulphur.—H. & C., oz. 2-4 (gm. 60.-120.). Sh. & Sw., oz. 1-2 (gm. 30.-60.). D., dr. ½-4 (gm. 2.-15.).

Tannalbin.—H. & C., dr. 1-4 (gm. 4.-15.). Foals and Calves, gr. 20-40 (gm 1.3-2.6).

Tannigen.—Foals and Calves, gr. 30 (gm. 2.).

Taraxacum.—H. & C., oz. 1-2 (gm. 30.-60.). Sh. & Sw., dr. 2-4 (gm. 8.-15.). D., dr. 1-2 (gm. 4.-8.).

Taraxacum, Fluidextract of.—Dose same as Taraxacum.

Taraxacum, Extract of.—H. & C., dr. 1-4 (gm. 4.-15.). D., gr. 5-30 (gm. .3-2.).

Terebene.—H. & C., dr. 2-6 (cc. 8.-24.). D., m. 5-15 (cc. .3-1.).

Terpin Hydrate.—H., dr. ½-2 (gm. 2.-8.). D., gr. 5-20 (gm. .3-1.3).

Tetanus Antitoxin.—H., 10 c.c. prophylactic dose, see p. 664.

Thymol.—H., dr. ½-2 (gm. 2.-8.). Sh. (single dose), 3 ss.-ii.ss. D., gr. 1-15 (gm. .06-1.).

Turpentine, Oil of.—Carminative—H. & C., oz. 1-2 (cc. 30.-60.). Sh. and Sw., dr. 1-4 (cc. 4.-15.). D., m. 10-30 (cc. .6-2.). Anthelmintic—H. & C., oz. 2-4 (cc. 60.-120.). D., dr. ½-4 (cc. 2.-15.). Diuretic—H. & C., dr. 2-6 (cc. 8.-24.).

Valerate of Ammonium.—D., gr. 2-5 (gm. .12-.3).

Valerate of Iron.—D., gr. 1-3 (gm. .06-.2).

Valerate of Zinc.—D., gr. 1-3 (gm. .06-.2).

Valerian.—H. & C., oz. 1-2 (gm. 30.-60.). D., gr. 10-60 (gm. .6-4.).

Valerian, Fluidextract of.—Dose same as Valerian.

VALERIAN, Tincture of.—D., dr. ½-2 (cc. 2.-8.).

VALERIAN, Ammoniated Tincture of.—D., dr. ½-2 (cc. 2.-8.).

VALERIAN, Oil of.—H., dr. ½-1 (cc. 2.-4.). D., m. 2-5 (cc. .12-.3).

VERATRINE.—H., gr. ½-2 (gm. .03-.12). C., gr. 2-5 (gm. .12-.3). D., gr. 1/50-1/10 (gm. .0012-.006).

VERATRUM.—H. & C., dr. ½-1 (gm. 2.-4.). Sh. & Sw., gr. 20-30 (gm. 1.3-2.). D., gr. 1/10-1 (gm. .006-.06).

VERATRUM, Fluidextract of.—Dose same as Veratrum.

VERATRUM, Tincture of.—H. & C., oz. ½-1 (cc. 15.-30.). Sh. & Sw., dr. 2-4 (cc. 8.-15.). D., m. 5-10 (cc. .3-1.)

WHISKEY.—H. & C., oz. 2-4 (cc. 60.-120.). Sh. & Sw., oz. 1-2 (cc. 30.-60.). D., dr. 1-4 (cc. 4.-15.).

WILD CHERRY, Syrup of.—D., dr. 1-4 (cc. 4.-15.).

WINTERGREEN, Oil of.—See Gaultheria.

YOHIMBINE HYDROCHLORIDE.—H. & C., gr. ¾-1½ (gm. 0.045-0.1). Sh. & Sw., gr. ½ (gm. 0.03). D., gr. 1/12-1/6 (gm. 0.005-0.01).

ZINC ACETATE.—H. & C., dr. 1-2 (gm. 4.-8.). Sh. & Sw., gr. 10-20 (gm. .6-1.3). D., gr. 2-3 (gm. .12-.2).

ZINC OXIDE.—H. & C., dr. 1-2 (gm. 4.-8.). D., gr. 5-10 (gm. .3-.6).

ZINC PHOSPHIDE.—D., gr. 1/10 (gm. .006).

ZINC SULPHATE.—H. & C., dr. 1-2 (gm. 4.-8.). Sh. & Sw., gr. 10-20 (gm. .6-1.3). D., gr. 2-3 (gm. .12-.2). Emetic—D., gr. 10-15 (gm. .6-1.).

POISONS AND ANTIDOTES.

NOTE.—In poisoning, the chemical antidote should be given first—if it is at hand. The next thing is to evacuate the stomach. Washing out the stomach is practically always done in human medicine, except in convulsions of strychnine poisoning and in poisoning by acids and caustic alkalies. This is readily performed in the case of the dog with assistance and may be accomplished in the horse. Where facilities for lavage are not at hand, an emetic should be given the dog, cat and pig. Mustard is the emetic usually at hand. The dog and cat take 1 tablespoonful, and the pig two, in water. Zinc sulphate is more effective; D. & C. gr. v; Sw. gr. xv, in two ounces of water. Apomorphine hydrochloride, under the skin, is the most certain of all; D. gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$; cats, gr. $\frac{1}{12}$.

ACETANILID, ANTIPYRIN, PHENACETIN.

Caffeine subcut., with an equal amount of sodium salicylate, H. gr. xxx; D. gr. ii. Strychnine sulph. H. gr. ii; D. gr. $\frac{1}{100}$ to gr. $\frac{1}{40}$. Atropine sulph. gr. $1\frac{1}{2}$; D. gr. $\frac{1}{40}$ subcut.

ACETIC ACID, See Acids.

ACIDS.

ACETIC, HYDROCHLORIC, NITRIC, OXALIC, PHOSPHORIC, SULPHURIC, TARTARIC.

Antidotes.—Magnesia, chalk, plaster scraped off the walls, soap—one of these, with demulcents as eggs, milk, and oil. Large quantities of water by the mouth.

ACONITE.

Empty stomach with tube; emetics put too much strain on the heart. Atropine under the skin is most valuable. Also digitalis, strychnine, alcohol, ammonia and ether are useful.

Tannic acid is partial antidote. Keep the patient quiet and do artificial respiration if necessary.

ALCOHOL.

Emetic or stomach lavage. Strong coffee by the mouth. Give subcutaneously, Caffeine with equal amount of sodium salicylate, H. gr. xxx; D. gr. ii. Strychnine nitrate under the skin, H. gr. i, D. gr. $\frac{1}{100}$ to gr. $\frac{1}{40}$. Inhalation of ammonia. Camphorated oil subcut. H. ℥i; D. m. xv.

ALKALIES, CAUSTIC.

AMMONIA WATER, QUICK LIME, POTASSIUM and SODIUM HYDRATE and CARBONATE.

Antidotes.—Vinegar or lemon juice in water, or weak solutions of citric or tartaric acids. Do not evacute the stomach. Demulcents as egg white, milk. External heat and mustard paste. Camphorated oil subcut. H. ℥i; D. m. xv.

AMMONIA WATER, See Alkalies.

Anesthetics, Ether, Chloroform.

Hold small animals upside down. Do artificial respiration. Try rhythmic traction of the tongue. Pour ether from a height of several feet on epigastrium. Adrenalin solution (1 to 1,000) injected into vein, H. ℥ ss; D. m. xxx. Atropine sulph. subcut. H. gr. 1½; D. gr. 1/60. Strychnine subcut. H. gr. 1; D. gr. 1/100 to gr. 1/60. "Digitalone" subcut. H. ℥ ss; D. m. xx to m. xxx.

Antimony, Tartaric Emetic.

Antidote.—Strong tea or tannic acid. Magnesia, slacked lime. Emetic or lavage if vomiting has not occurred. Give cathartic of salts or oil. Inject subcut. "digitalone," H. ℥ ss; D. m. xx to xl. Give under the skin strychnine sulph. H. gr. i; D. gr. 1/100 to gr. 1/40. Heat and mustard paste externally.

Antipyrin, See Acetanilid.

Arsenic.

Antidote.—Freshly prepared "arsenic antidote" or hydrated sesquioxide of iron in large amount by the mouth. Perform lavage if possible or give emetic. The antidote is of little value. Caffeine, with equal amount of sodium benzoate, H. gr. xxx; D. gr. ii. subcut. "Digitalone" subcut., H. ℥ ss; D. m. xx to m. xl. Morphine subcut., H. gr. iii, D. gr. ss. Heat and mustard paste externally.

Amyl Nitrite. Nitroglycerin.

Inhalation of Ammonia. Alcohol subcut. H. ℥i; D. ℥i to ii. Atropine sulph. subcut. H. gr. 1½; D. gr. 1/60. Strychnine sulph. subcut. H. gr. i; D. gr. 1/100 to gr. 1/40. Injectio ergotin. hypoderm. H. ℥ii; D. m. x.

Atropine. Belladonna.

Emetics or lavage. Chloroform inhalation for convulsions. Caffeine, with equal amount sodium benzoate, subcut. H. gr. xxx; D. gr. i. Strychnine sulph. subcut. H. gr. ii; D. gr. 1/100 to gr. 1/40. Pilocarpine. Artificial respiration.

Barium Chloride.

Antidote. Magnesium or sodium sulphate. Lavage with same.

Belladonna, See Atropine.

Cantharides.

Egg white, gruel, linseed tea, barley water; avoid oils. Lavage or emetic. Tinc. opium for pain. H. ℥ii; D. m. x to xv. Give large amount of sodium bicarbonate in drinking water. High enemata of 5% sodium bicarbonate solution.

Carbolic Acid, See Phenol.

Carbon Monoxide, See Gas Poisoning.

Carbonic Acid, See Gas Poisoning.

Chloral.

Lavage or emetics. Strychnine sulph. subcut. H. gr. ii; D. gr. 1/100 to 1/40. Caffeine subcut., with equal amount sodium salicylate, H. gr. xxx; D. gr. ii. Artificial respiration. Heat and mustard paste externally.

Chloroform, See Anesthetics.

Coal Gas, See Gas Poisoning.

Cocaine.

If swallowed give emetic or lavage. Ether inhalation if convulsions present. Morphine sulph. subcut. H. gr. v; D. gr. ss. Alcohol by mouth. H. ℥ii; D. ℥ii. Strychnine sulph. for collapse, H. gr. i; D. gr. 1/100 to gr. 1/40 subcut.

Colchicum.

Antidotes.—Tannic acid, oil, milk, linseed tea, barley water. Give emetic or lavage. Tinc. opium. H. ℥iii; D. m. x to xv. Atropine sulph. subcut. H. gr. 1½; D. gr. 1/60. Caffeine subcut., with equal amount sodium salicylate, H. gr. xxx; D. gr. ii. Camphorated oil, subcut. H. ℥i; D. m. xv. Heat and mustard paste externally.

Conium.

Emetic or lavage. Strychnine sulph. subcut. H. gr. ii; D. gr. 1/100 to gr. 1/40. "Digitalone," subcut. H. ℥ ss; D. m. xx to xl. Camphorated oil subcut. H. ℥i; D. m. xv. Heat and mustard paste externally.

Copper Sulphate and other soluble salts.

Antidotes.—Potassium ferrocyanide, magnesia, egg white, milk. Emetic or lavage. Morphine subcut. H. gr. iii; D. gr. ss. Mustard paste rubbed on belly.

Croton Oil.

Egg white, milk, linseed tea. Emetic or lavage. Tinc. opium H. ℥iii; D. m. x to xv. Alcohol, H. ℥ii; D. ℥i. Heat and mustard paste externally.

Creosote, See Phenol.

Digitalis.

Antidote.—Tannic acid. Give emetic or lavage. Keep the patient quiet. Tinc. aconite, H. ℥i; D. m. x. subcut. Camphorated oil, subcut., H. ℥i; D. m. xv. Caffeine, subcut. with an equal amount of sodium salicylate. H. gr. xxx, D. gr. ii. Heat and mustard paste externally.

Eserine, See Physostigmine.

Ether, See Anesthetics.

Gas Poisoning, Carbon Monoxide, Coal Gas, Marsh Gas, Carbonic Acid.

Artificial respiration, direct transfusion of blood. Cold douches on the head. Apply mustard paste to body.

Gelsemium.

Give emetic or lavage. "Digitalone" subcut., H. ℥ ss; D. m. xx to m. xl. Strychnine sulph. subcut., H. gr. i; D. gr. 1/100 to gr. 1/40. Mustard paste and heat externally. Artificial respiration.

Hydrochloric Acid, See Acids.

Hydrocyanic Acid, See Prussic acid.

Hyoscyamus, See Atropine.

Iodine.

Flour or starchy substance mixed with water. Give emetic or lavage. "Digitalone" subcut., H. ℥ ss; D. m. xx to m. xxx. Strychnine sulph. subcut., H. gr. i; D. gr. 1/100 to gr. 1/40. Heat and mustard paste externally.

Iodoform.

Absorption from skin or internally. Give sodium bicarbonate internally in large doses. Saline intravenous infusion. Alcohol subcut., H. ℥ii; D. 3i. Hot blankets to cause sweating.

Jaborandi, See Pilocarpine.

Lead Acetate and Soluble Lead Salts.

Antidotes.—Magnesium or sodium sulphate, or milk and eggs. Give emetic or lavage. Morphine sulph. subcut., H. gr. iii; D. gr. ss. Chronic Poisoning. Potassium iodide, H. & C. 3ii to 3iv thrice daily. Linseed oil.

Lime, See Alkalies.

Lobelia.

Give emetic or lavage. Morphine sulph. subcut. to allay pain and vomiting, H. gr. v; D. gr. ss. Caffeine, with an equal amount of sodium salicylate, H. gr. xxx; D. gr. ii. subcut. Strychnine sulph. subcut. H. gr. i; D. gr. 1/100 to gr. 1/40. Mustard paste and heat externally.

Mercuric Bichloride and Other Soluble Salts of Mercury.

Antidotes.—Egg white, tannic acid. Give emetic or lavage. "Digitalone" subcut. H. ℥ ss; D. m. xx to m. xl. Atropine sulph. subcut., H. gr. 1½; D. gr. 1/60. Mustard paste and heat externally. Mercurial salivation. Use saturated potassium chlorate solution to swab mouth thrice daily and stop ingestion of mercury.

Morphine and Opium.

Antidote.—Potassium permanganate, H. 3ii to 2 qts. of water. D. gr. xv in half a pint of water. Give emetic. Lavage most important whether drug swallowed or injected. Caffeine subcut., with an equal amount of sodium salicylate, H. gr. xxx; D. gr. ii. Strychnine sulph. subcut., H. gr. i; D. gr. 1/100 to gr. 1/40. General faradic stimulation of the skin, or whipping of the animal. Artificial respiration.

Nitrate of Silver, See Silver nitrate.

Nitric Acid, See Acids.

Nitroglycerin, See Amyl nitrite.

Nitrohydrochloric Acid, See Acids.

Nux Vomica, See Strychnine.

Opium, See Morphine.

Oxalic Acid, See Acids.

Phenacetin, See Acetanilid.

Phenol, Carbolic Acid, Creosote.

Antidote.—Magnesium or sodium sulphate; benefit doubtful. Give emetic or better lavage with 10 per cent. solution of alcohol. Strychnine sulph. subcut., H. gr. i; D. gr. 1/100 to gr. 1/40. Atropine sulph. subcut. H. gr. 1½. D. gr. 1/60. Camphorated oil subcut., H. ℥i; D. m. xv. Artificial respiration. Saline intravenous infusion. Mustard paste and heat externally.

Phosphorus Acid, See Acids.

Tartaric Acid, See Acids.

Tobacco.

Antidote.—Tannic acid. Give emetic or lavage. Strychnine sulph. subcut., H. gr. ii; D. gr. 1/100 to gr. 1/40. Camphorated oil subcut. H. ℥i; D. m. xv. Mustard paste and heat externally.

Phosphorus.

Antidotes.—Potassium permanganate, H. ℥ii in 2 qts. of water; D. gr. xv in half pint of water, or hydrogen dioxide, or copper sulphate, H. ℥ii; D. gr. x. in solution. Give emetic or lavage. Avoid oil and fats. Give large doses of sodium bicarbonate for secondary symptoms.

Physostigmine, Eserine, Calabar Bean.

Atropine sulph. subcut. H. gr. 1½; D. gr. 1/60. "Digitalone," subcut., H. ℥ ss; D. m. xx to m. xl. Alcohol subcut. H. ℥iv; D. ℥ii. Strychnine sulph. subcut., H. gr. i; D. gr. 1/100 to gr. 1/60. Artificial respiration.

Pilocarpine. Jaborandi.

Atropine sulph. subcut. H. gr. 1½; D. gr. 1/60.

Potassium Carbonate, See Alkalies.

Potassium Cyanide, See Prussic acid.

Potassium Hydrate, See Alkalies.

Prussic Acid. Hydrocyanic Acid. Potassium Cyanide.

Artificial respiration. Lavage. Atropine sulph. subcut., H. gr. i; D. gr. 1/100, every half hour. Camphorated oil subcut., H. ℥i; D. m. xv. Intravenous injection sodium hyposulphite, H. ℥i; D. gr. xxx in solution. Mustard paste and external heat.

Savin.

Give lavage or an emetic. Cathartics, as epsom salts, or castor, or linseed oil. Morphine sulph. subcut., H. gr. v; D. gr. ss.

Silver Nitrate.

Give emetic or lavage with salt and water. Salt is the antidote and must be given freely. Demulcents, egg white, sweet oil, milk, soap and water. Morphine sulph. subcut., H. gr. iii; D. gr. ss. Mustard paste and heat externally.

Snake Bite.

Ligature about limb between wound and heart. Excise wound or cauterize it with a hot iron. Inject about bite 1% solution chlorinated lime, or 1 to 1000 solution potassium permanganate. Calmette's antivenin. Strychnine sulph. subcut., H. gr. i; D. gr. 1/100 to gr. 1/40.

Sodium Carbonate, See Alkalies.

Sodium Hydrate, See Alkalies.

Strychnine. Nux Vomica.

Lavage with tannic acid solution under influence of amyl nitrite or chloroform inhalation. If convulsions are already present give amyl nitrite subcut. H. ℥i; D. m. v and follow with chloroform inhalation. Chloral and potassium bromide per rectum in starch water. H. of each ℥ii; D. gr. xxx each.

Sulphate of Copper, See Copper.

Sulphuric Acid, See Acids.

Tartaric Emetic, See Antimony.

Turpentine, Oil of.

Give emetic or lavage. Give demulcents:—Egg white, gum arabic solution. linseed tea. Epsom salts, Linseed oil. Intravenous saline infusion.

Zinc Salts, Soluble.

Lavage if emesis is not copious. Cathartics, as linseed or castor oil, or epsom salts. Morphine sulph. subcut., H. gr. v; D. gr. ss. Stimulants. Mustard paste and heat externally.

GENERAL THERAPEUTIC MEASURES.

Food and Feeding.

In order to comprehend the rationale of feeding in disease it is essential to know something of the principles of feeding in health. A food has been defined as "that which, being innocuous in relation to the tissues, is a digestible, absorbable substance that can be oxidized in the body and decomposed in such a way as to give up to the body the forces it contains."

A complete food is composed of organic and inorganic constituents. The inorganic matters, with the exception of common salt, and rarely phosphate of lime and sodium, are usually present in sufficient quantity in ordinary food. The organic components of vegetable food stuffs are divided into nitrogenous and non-nitrogenous classes. These are analogous to the constituent parts of the animal body into which they are transformed. The greater portion of animal tissue is made up of nitrogenous elements, while the larger part of plants is composed of non-nitrogenous material. Among the nitrogenous elements the most important are the proteids. Gluten of flour is an example of a vegetable proteid; while white of egg, casein of milk, and fibrin of blood represent animal proteids. Fat exists as such in both plants and animals. A single, chemical compound, as protein, is known as a nutrient in relation to feeding. The nutrients of importance are proteids, fat, and carbohydrates. The first two are common to animal and plant structure; the latter to plants alone. A complete food contains the three nutrients just mentioned and inorganic substances. Carbohydrates include such bodies as sugar, starch, and cellulose, or woody matter of plants. Proteids consist of carbon, hydrogen, oxygen, nitrogen, and sulphur, united in different proportions. Carbohydrates are composed of carbon, hydrogen and oxygen. Fat is similar in composition to carbohydrates, but in its combustion outside the body yields two and a quarter times as much heat as that produced by an equal weight of carbohydrate. Fat as a nutrient is therefore empirically regarded as equivalent to two and a quarter times the same weight of carbohydrate material.

Hitherto computation of the food requirements has been based simply on the pounds of digestible nutrients and the proportion of

proteids to carbohydrates, this proportion being known as the nutritive ratio.

Now scientific feeding is founded on the fuel value or energy value of food. The fuel value means the amount of heat that is given out by food in its combustion in the body. There is much less heat formed by the combustion of food within the body—on account of losses in food undigested and fermented in the bowels and escaping incompletely burned in the urine—than would occur in food burned outside the body. The heat or energy value of food is measured in calories or therms. A calorie is the quantity of heat necessary to raise 1 gram of water 1° C. A therm is the amount of heat required to raise 1 kilo. of water 1° C. Tables based on the most elaborate experiments showing the actual amount of fuel or energy value of foods, together with the amount of digestible protein and dry matter contained in them, must be consulted in calculating daily rations.

Thus, for maintenance of animals of 1,000 lbs. live weight per diem, it has been found that cattle require 0.5 lb. of digestible protein and food of the energy value of 6.0 therms. Horses require 1.0 lb. digestible protein and food of a fuel value equal to 7.0 therms.

The daily food requirements of grown cattle are such that for each pound of digestible protein there should be 8 to 10 lbs. of carbohydrates and 20 to 30 lbs. of total dry matter. More important still, it has been found that there are necessary—*in addition to the maintenance requirements of cows*—0.05 lb. of digestible protein and 0.3 therm in energy value in the daily ration for each pound of milk produced.

As a practical application of the foregoing, suppose that we compute a ration for cows giving 25 lbs. of milk daily and weighing 850 lbs. Consulting a table showing maintenance requirements, we find that 0.45 lb. of digestible protein and food of energy value of 5.6 therms are necessary. Multiplying the additional requirements for each pound of milk produced (as above) by 25, we find that 1.25 lbs. of protein and 7.5 therms are necessary for this milk yield—beside the maintenance requirement. Adding the requirements for maintenance to those for milk yield we get the total daily requirements for cows weighing 850 lbs. and yielding 25 lbs. of milk as follows:

	Digestible protein.	Energy value.
	Lbs.	Therms.
For maintenance	0.45	5.6
For 25 lbs. of milk	1.25	7.5
	1.70	13.10

We shall now have to consult a table* showing the energy value, proteid content, and dry matter in all ordinary fodders, and combine them so that they shall possess in the daily ration 1.7 lbs. of digestible protein, energy value of 13.10 therms, and dry matter equal to 20 to 30 lbs.

The particular food stuffs must be selected so that they shall be the cheapest in the locality in which the feeding is done.

The mechanism of the animal body is always "running," and an animal at rest is like a motor car at a stand-still with the engine moving. Therefore no more protein is required by a horse at light-work than at rest, for repair of the machine. More fuel for working* the machine is, however, needed. The requirements for working horses are: For light work, digestible protein, 1.0 lb.; therms, 9.8. For moderate work, digestible protein, 1.4 lb.; therms, 12.40. For heavy work, digestible protein, 2.0 lbs.; therms, 16.00.

Horses doing hard work, growing and pregnant animals, and all animals supplying nitrogenous products, as wool and milk, demand more nitrogen in their food. The proteids, as we have seen, constitute a large proportion of the solids and fluids of the body. The protein absorbed into the blood is utilized in two ways. One part is Energy-forming, the circulatory protein of Voit. The other is Tissue-building, or the Organic Protein of Voit.

That part which is devoted to energy-producing is not transformed into tissue but is split up (katabolized) by the cells, or enzymes within the cells (chiefly of muscles), and thus produces heat or energy.

The other part is directly built into living protoplasm. If the amount of circulatory protein is deficient, then the organized protein is called upon, the tissues are robbed of their substance, and the body emaciates. When a larger amount of protein is contained in the blood, we have a proportionately larger elimination of nitrogenous matter in the urine, as equilibrium is soon established in the adult animal of constant weight, so that the amount of nitrogen eliminated equals that ingested. In young and growing animals a portion of the nitrogen does not reappear in the urine, but is utilized in tissue formation. This also applies to previously starving animals on being well fed. An excess of circulating protein, besides being wasteful economically, is harmful in causing various disordered conditions, resulting in the formation of products of imperfect oxidation.

The vegetable proteids are transformed into bodies of simpler chemical composition in the stomach and are there converted in part

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* Armsby, Bull. 346, U. S. Dep't. Agric.

by the gastric juice, but chiefly by pancreatic (trypsin), biliary and intestinal ferments in the intestines, into peptone, proteoses, and possibly acid and alkali and native albumin.

The epithelial cells of the intestines possess the power not only to absorb the peptone, but to transmute it into more complex isomeric compounds, as serum albumin, serum globulin and fibrinogen; special cells being employed in the formation of particular compounds.

Any peptone not so converted by the intestinal epithelium becomes a poison when absorbed into the entero-hepatic circulation, but its toxicity is destroyed by the liver cells. In regard to the metabolism and fate of proteids, energy is not only directly liberated by the decomposition of the energy-producing protein in the muscle cell but is also formed by the functional activity of cell protoplasm in which katabolic changes occur. So that the tissue-building protein is eventually an energy-producer as well. Elimination of nitrogenous matter is not increased by muscular activity, nor proteid metabolism, as carbohydrates furnish the fuel for the mechanical work—with increase of CO_2 and H_2O elimination. The katabolism of protein in muscles then goes on independently of, and is not augmented by, muscular contractions.

In the course of the metabolic processes in the muscles there are intermediate products set free—as kreatin, leucin, glycocoll, sarcolactic acid, etc. These products are finally split up (katabolized) or synthetized (anabolized) in the liver with the formation of urea, uric acid, phosphates, sulphates, etc., as end-products, with the liberation of heat. From its absorption to the final urea stage each gram of protein liberates energy or heat equal to 4.1 calories.

This heat formation is of extreme importance in stimulating and sustaining nervous action.

The following rôle is played by protein as a nutritive:—

1. It is the building material for cell protoplasm of tissues of all kinds.

2. It forms energy directly by undergoing destruction without tissue-building.

3. It may be so transformed (through its H and C) that it is deposited as fat.

A dog can live on lean meat (pure protein) for months and gain in weight.

Carbohydrates of the food, as starch and sugar, are converted by the enzymes of the intestinal mucosa into sugars—as dextrose, levulose and galactose, which pass into the portal circulation to the liver where they are converted into glycogen, and stored as such, except a part of the sugars which are carried to the muscles and there converted into glycogen.

The glycogen undergoes combustion in the liver and muscles with a production of heat equal to 4.18 calories for each gram of carbohydrates. CO_2 and water are end-products. Sugar metabolism is under the control of the internal secretions of the pancreas, adrenal, thyroid and pituitary glands.

These either aid in the storage of sugar as glycogen in the liver (pancreas), or, in excessive and abnormal amount (adrenal, pituitary and thyroid glands), hinder this action and allow sugar to pass through the liver unchanged and escape into the blood and urine, thus causing diabetes. The heat production, as in the case of the combustion of proteids, is of great importance in sustaining nerve action.

Fat in the food is emulsified by the bile and by the pancreatic and intestinal secretions and is absorbed as fatty acids, glycerol and soaps by special cells of the intestinal mucous membrane and passes into the lymphatics as emulsions of fat; thence into the thoracic duct, and is finally oxidized into carbonic dioxide and water with production of heat and energy. In what part of the body oxidation of fat occurs is unknown. In the combustion of 1 gram of fat heat equal to 9.4 calories is liberated.

Carbohydrates do not directly furnish tissue elements, but do so indirectly in preventing decomposition (to some extent) of protein in the body, and in lessening its consumption. In this way the comparatively inexpensive carbohydrates will compensate for an insufficient ration of costly proteids.

It is asserted that this action of carbohydrates is explained by the fact that these nutrients have a greater affinity for oxygen than proteids and so are the first to undergo combustion.

The term albuminoid was formerly used as synonymous with proteid, but is now employed to include nitrogenous bodies (gelatin) derived from protein in the body but not convertible into proteids. These bodies do not take the place of proteids, but appear to fulfil the functions of circulating protein, and, like carbohydrates, conserve protein consumption, but are not tissue builders.

Carbohydrates aid directly in the production of fat. Fat in the food may be directly assimilated as such if there is a sufficient carbohydrate and proteid ration to protect it from decomposition. The rôle carbohydrates play includes:

1. The formation of tissue indirectly by protecting the proteid elements from combustion with an insufficient nitrogenous diet.
2. The generation of heat, energy, or mechanical work.
3. The production of fat.

Carbohydrates cannot be relied upon as sole articles of food. The fat of the body is derived from the decomposition of proteids and carbohydrates, and directly from fat contained in the food.

Fat lubricates the tissues, and a reasonable accumulation serves as a store of potential energy to be called upon in time of need, when its action is similar to that of carbohydrates. The main source of muscular energy, movement, or mechanical work, is thought to reside in the carbohydrates, because with excessive muscular work there is increased evolution of heat, carbonic dioxide and water, but no material increase in excretion of nitrogen in the urine. In so far as muscular energy and power depend upon a good machine, in so far do the proteids aid the work of the machine by keeping it in good repair and working order. From this point of view the proteids represent the mechanism by which the work is done; the carbohydrates the fuel necessary for its performance. It must be kept in mind that this is but a general statement, since muscular work is also done by protein, and may be wholly done by it, as shown by dogs living on lean meat. The exact relative value of carbohydrates and proteids in the production of the vital forces is still *sub judice.*

The classes of food stuffs for the larger animals embrace both green and dry fodder, consisting of the whole plant minus the roots; parts from which the more valuable portions have been removed, as straw; tubers and roots containing a large percentage of water; the seeds or grains, constituting the most concentrated food: and the seed coverings or chaff.

Refuse and bye-products of manufacture are extensively used, as bran, cottonseed meal, linseed meal, and brewers' grains. In addition, animal matter, as flesh meal, bone meal, and dried blood, are sometimes of value. Pasture grass may be taken as a standard of comparison for green fodders. In 100 lbs. of grass there are approximately digestible:

Protein	1.04 lbs.
Fat	0.5 "
Carbohydrates	10.34 "

Green clover contains considerably more, green rye slightly more, and green oats somewhat less protein; while in green corn fodder there is only about half as much protein. Roots, as compared with green pasture grass, possess only one-third the quantity of protein and solids. Potatoes, however, have double the nutritive value of roots. Comparison is made in reference to protein, as that is by far the most valuable nutrient, and the amount of carbohydrates and fat do not vary much in similar kinds of fodder.

Meadow hay, including such common varieties as timothy and red top, may be taken as a standard of comparison for dry fodder. In 100 lbs. of timothy hay there are approximately digestible:

Protein	3.65 lbs.
Fat	.78 "
Carbohydrates	45.8 "

Clover hay has double the amount, and rowen or aftermath about one-third more protein than is contained in ordinary meadow hay. Oats may be selected as a standard of comparison for grains. 100 lbs of oats contain of digestible nutrients as follows:

Protein	8.36 lbs.
Fat	4.5 "
Carbohydrates	45.0 "

Corn yields slightly less protein and considerably more carbohydrates and fat, while cottonseed meal contains nearly three times as much protein, and four times as much fat as are found in oats. Bran (or shorts) has approximately the same chemical composition as oats. The straw of wheat, barley, rye, oats, and corn have a somewhat similar value. In 100 lbs. of wheat straw there are digestible:

Protein	0.37 lbs.
Fat	0.3 "
Carbohydrates	36.00 "

In order to compare the composition of food with that of the tissues into which it is converted, we submit the following:

PERCENTAGE COMPOSITION OF LIVE ANIMAL.

IN 100 LBS. OF WELL FED LIVE OX THERE ARE:	
Protein	15.8 lbs.
Fat	7.1 "
Ash	4.8 "
Water	54.3 "
Contents of digestive tract	18.0 "

Certain of the fodders are especially adapted or otherwise for the various domestic animals. Green clover is prone to fermentation and the formation of flatulency if given in large quantities to any animal. A sudden change from dry to luxuriant green food is always undesirable for a similar reason. Green grass cut short by a lawn mower should not be given horses, as it is swallowed in an unmasticated condition and leads to indigestion and colic. Corn chop is a frequent cause of colic and alfalfa of impaction of the colon in horses. Pasturing on the tops of sugar beets, after the beets have

been removed is responsible for colic in horses and gastro-enteritis in cattle, sheep and swine in parts of this country. Potatoes and roots are more suitable for ruminants than for horses; yet upon the latter they act as natural and agreeable laxatives, and form a palatable addition to dry fodder, particularly carrots. The best variety of hay for horses consists of good bright timothy or herds grass with a slight admixture of red top and clover. Carrots should be sliced longitudinally to prevent choking when given to horses. Clover hay is dusty and apt to provoke "heaves" in horses, and that, together with rowen, is more appropriate for ruminants.

Bran is but poorly digested by horses, yet acts favorably as a laxative when given once or twice a week mixed with boiling water and plenty of salt, constituting a "bran mash." Bran takes the place of oats as a nitrogenous food for ruminants, and is less expensive. Cottonseed meal, being extremely rich in nitrogen, and usually in oil or fat, is not easily digested by any animal, but may be given in quantities of a quart or two to ruminants, and from half a pint to a pint to horses, daily. Cottonseed meal is supplied cattle to compensate for a deficiency of nitrogen in the food, while in horses it acts as a slight laxative and may improve the general condition. Straw and corn fodder are not readily digested by horses unless cut and steamed, but are suitable for ruminants and are often preferable to a poor quality of hay. The demands of the system for food vary in relation to tissue change, which is diminished by rest, increased by work, and either accelerated or decreased by disease. The requirements for nutriment are greater during the growing period and for the formation of the various natural products, as milk or wool. The state of the digestive organs and assimilative powers guide us in selecting the kind and quantity of food desirable. In acute disease it is advisable to feed little and often, the food being prepared in the most digestible and palatable form, and in as great a variety as attainable. We may restrict the diet as a whole or in part. Starving diminishes circulatory protein, increases tissue waste, weakens an animal, and lessens the natural resistance against disease. Restricting the diet is useful in controlling unmanageable animals, in diminishing sexual excitement, and in the treatment of plethora when combined with proper exercise. In most acute inflammatory diseases, as in acute laminitis, a restricted laxative diet is desirable, as steamed oats with bran and salt, roots and green fodder. In acute indigestion, or in acute inflammation of the alimentary tract, and in acute nephritis, all food should be withheld for at least 24 hours. In acute peritonitis all food is contraindicated, by the mouth. In the milder forms of acute gastro-enteritis we must restrict the diet to small quantities of easily digested food, as cracked or steamed oats, chopped hay

and gruels, with the addition of a little green fodder or roots for horses; while carnivora are given milk and lime water. In chronic digestive disorders the food must be readily digestible and assimilable, and of a nitrogenous character, since anemia and malnutrition follow the defective digestion and absorption. In chronic indigestion or gastro-enteritis of horses, Zuill recommends oats (boiled, scalded or steamed, and allowed to stand 12 hours), 2 parts; bran, 1 part; and malted barley, 1 part. The addition of salt and a little green fodder to this ration is palatable and desirable. The dietary for constipation in horses should consist of bran mashes twice a week with plenty of salt; roots and green fodder at frequent intervals, combined with suitable exercise and appropriate drug treatment. Dogs suffering from constipation may be given raw liver twice a week, or may be put on an occasional or exclusive diet of one of the commercial dog breads or biscuits. These are laxative and are invaluable in eczema of dogs. Avoid oatmeal, and feed bread, soup and milk in acute eczema. If constipation is very obstinate, total abstinence from all food, water excepted, for a time, followed by the use of lean meat with salt and beef tea, are indicated till the bowels are emptied manually or by enemata. The ration for diarrhea embraces the partial restriction of water, which increases the bulk and fluidity of the intestinal contents and so stimulates the movements of the bowels. If the diarrhea is so severe as to endanger life, an abundance of pure or boiled water should be allowed in order to compensate for the loss of fluid from the blood.

Theoretically, an albuminous diet is indicated in diarrhea because of the loss from the blood and tissues, and because intestinal digestion is disordered and starchy food would be undigested and cause fermentation, etc. Practically, a certain amount of starchy food seems to be serviceable in the treatment of diarrhea. Horses and cattle should be given cooked flour or barley gruel and roasted oatmeal and cracked oats. Coarse foods, as bran and straw and green fodder, are not allowable. Swine should be supplied with gruels of boiled milk and barley, flour or oatmeal (strained).

Fowl with diarrhea may be fed on boiled rice and given a few drops of laudanum two or three times daily. Dogs and cats should have boiled milk, boiled rice or strained rice gruel, cooked lean meat and crackers. Beef juice and white of egg in water are of value. Young calves, with diarrhea, should receive whey, broths and rice flour gruel. These dietaries should be employed in conjunction with other measures, as the preliminary use of a laxative, rest, the avoidance of too rich milk, quiet, and external heat and drug treatment. Young suckling animals, as foals and calves, may be fed on cooked and strained oatmeal or barley gruel made with milk, if the mother's

milk does not agree. In severe attacks of gastro-enteritis, or in gastric or intestinal ulceration with hemorrhage from the stomach or bowels (after preliminary starving), the food should be bland and fluid, as soaked bread, oatmeal, barley or flour gruels, linseed tea (made by boiling linseed in a muslin bag immersed in water), and small quantities of green fodder for the larger animals; while milk and lime water, white of egg and water, broths and beef juice are indicated for carnivora. In the latter animals we may have to resort to predigested food given by the mouth, or, if vomiting is persistent, by the rectum.

The diet in cases of catarrhal jaundice should be easily digestible, bland, and such as will not require much bile for its digestion. The larger patients should be given gruels, steamed cracked oats, young and tender green food, cooked potatoes, together with alkalies and other appropriate remedies. Dogs are allowed milk and lime water, crackers, bread and cooked lean meat. Feeding in hemoglobinuria or "black water" of horses must be restricted to the use of gruels, green fodder and a little hay in the early stages of the disorder. Food is usually withheld 12 hours before surgical operations, and this, in addition to the administration of a cathartic, will prevent injury in casting the larger animals, which might follow were the digestive tract overfull. It will also lessen the danger of intestinal fermentation and absorption of toxins from the bowels, which may occur after operation, owing to an enfeebled digestive action. If dogs are starved before surgical operation, vomiting is prevented during or after etherization. Water alone may be restricted to advantage in obesity, cardiac disease with edema, or in the treatment of chronic exudations, as in hydrothorax. Water may be allowed in these conditions only once daily, or even every other day; and this treatment may be combined with the use of saline cathartics in strong animals. The specific gravity and density of the blood and the tendency to absorption from the tissues and cavities are increased. By the same process the quantity of blood is diminished and the load put upon the heart is lessened, both of which may prove beneficial in cardiac diseases.

A full, or restorative diet should be especially rich in protein. Generous feeding is distinctly in order in the treatment of general debility, malnutrition, anemia, weakness of the digestive organs, convalescence from acute diseases and in animals particularly sensitive to cold, or in those which sweat easily. A full diet is also useful in overworked animals and in those subject to losses from increased secretion, excretion, or exudation, as in chronic suppuration, diarrhea, albuminuria, ascites and edema. A restorative diet for herbivora includes grain, as corn, bran, oats and cottonseed meal; hay

and grass, with occasionally beef meal, milk and eggs. For omnivora, corn, potatoes, blood, beef meal, milk and soups. For carnivora, meat extracts, cream, milk, eggs, broths and meat juice. In most wasting diseases, fat, protein and water are the food elements especially needful. An abundance of water stimulates the appetite, secretions, excretions, tissue changes and vital processes generally. Salt should be given freely as an aid to digestion in increasing the formation of hydrochloric acid, and indirectly that of pepsin. Alcohol, being a nutritive and capable of easy absorption, assimilation and decomposition in the body, forms a most valuable adjunct to a restorative diet. A deficiency of lime in the food is occasionally the cause of rickets in the young, and fragilitas ossium in the old, but more frequently these diseases are due to defective digestion, assimilation, or excessive lactation. Bone meal may be fed to advantage in such affections. It contains both lime and phosphoric acid and should be given in small quantities (1 tablespoonful to large animals; 1 teaspoonful to small patients) on the food in connection with the administration of hydrochloric acid and bitters.

In fever a restricted diet is often necessary in the more acute stages, with loss of appetite, diminished secretions, and movements of the stomach, but as soon as convalescence sets in the increased tissue waste produces an excessive demand for food and the digestive organs may become overtaxed. The initial dietetic treatment of fevers consists in the use of oats, bran mashes, and gruels, with the addition of a small quantity of grass or roots for horses. The change from this diet should be very gradual to a dry, coarse fodder, in order to avoid digestive disorders. The bitters, alcohol, hydrochloric acid, and salt, together with a copious supply of water, will furthermore aid convalescence. Carnivora, with fever, should be fed milk, beef juice, broth, bread, oatmeal and a small quantity of cooked lean meat.

Obesity is treated most advantageously by proper feeding. A certain amount of fat is essential in the body in lubricating the tissues, in acting as a protection against cold, in serving as an enveloping and shielding cushion to the underlying tissues, and finally in supplying a store of nutrition. Animals living in cold climates are covered symmetrically by fat, but those indigenous in hot countries have accumulations of fat in masses to avoid over-heating the body. This is seen in the hump of the camel, zebu and Brahmin bull. When the camel is severely taxed, the fat is consumed and the hump becomes loose and flabby. House dogs overfed and insufficiently exercised, horses, and other animals kept for breeding purposes, are those most commonly afflicted with obesity. Fat in the body may be formed from fat, albuminoids, and carbohydrates of the food. Carbohy-

drates, if in excess of the needs of the economy, protect the fat in the food from decomposition and so enable it to be stored in the body. Protein may also protect the consumption of fat of the food, for it is broken up into nitrogenous and non-nitrogenous elements, and the latter may be transformed into body fat. The accumulation of fat proceeds most readily when there is an abundance of fat in the food, in addition to the other nutrients; less so when the ration consists of fat and albuminoids, or of carbohydrates and albuminoids; and least of all with a diet consisting of pure protein. The latter, then, is the food to be approached as near its purity as advisable. If a proteid ration is followed too closely, digestive disorders, loss of strength and nervous disturbances are likely to occur. The fat resulting from the decomposition of a pure protein fodder is usually not sufficient to supply the needs of the body, and the organized fat is gradually called upon to supply the deficiency in the food.

Exercise, cathartics, diuretics and diaphoretics, together with venesection, are synergistic measures. As emaciation proceeds, we must add more and more non-nitrogenous material to our ration. Fat is said to accumulate most readily in the vicinity of vascular areas where the flow of blood is retarded, and therefore oxidation, combustion, and molecular activity diminished. Exercise, on the other hand, stimulates the circulation, while deprivation of water makes the blood-current more rapid by decreasing the amount of blood. Both therefore favor the destruction of fat. Vogel has reported good results in reducing obesity by the use of the following rations. From 19 to 26 weeks are required for a cure.

DAILY RATION FOR THE HORSE.

Oatmeal	7 lbs.
Straw	3.5 "
Hay	7 "
Linseed meal	1 "
Salt	5 per cent. of above.

DAILY RATION FOR DOG WEIGHING 115 LBS.

Cooked oatmeal	3 lbs.
Fat	¼ "

SAME LATER.

Oatmeal	1 lb.
Flesh meal	½ "
Fat	¼ "
Salt	1 teaspoonful.

DAILY RATION FOR FAT SETTER OR POINTER.

Lean meat	1½ lbs.
Bread	1½ "
Fat	3 oz.

Animals suffering from fatty degenerative changes do not stand such a rigid diet as the foregoing. These animals are affected with a weak heart, due to fatty degeneration of the myocardium, with atrophy of its muscular fibres. They have dyspnea on exertion. The cardiac insufficiency leads, in its turn, to secondary troubles, as catarrh of the digestive and respiratory organs, and disorder of the liver and kidneys, following general passive congestion. The treatment should be directed in such cases to lessening the amount of blood and the work put upon the heart, by limiting the ingestion of water, and by strengthening the heart with appropriate stimulants. The activity of the skin should be excited by frequent grooming and the use of diaphoretics, while the activity of the kidneys should be enhanced by the employment of diuretics. We are prevented from feeding an exclusively nitrogenous diet in these cases, as the oxidizing power of the blood is not sufficient to decompose it, neither is it safe or advisable to quickly remove the fat, as cardiac failure might ensue. Small quantities of water are allowed, given two hours after feeding. The general ration should be rich in proteids and also contain a moderate amount of fat and carbohydrates.

ARTIFICIAL FEEDING.

Artificial feeding consists in the introduction of food into the body other than in the ordinary way by the mouth. Rectal feeding is the only procedure of much value. The agents employed must be bland, and capable of easy absorption and assimilation. If the food is at all irritating, tenesmus and ejection quickly occur. From two to four ounces of liquid nourishment may be given to small or medium-sized dogs; from four to eight ounces to large dogs. One quart may be employed for horses. The nutrient enema should be introduced into the bowel through a flexible rubber tube carried up into the colon. An hour before the enema is given the bowel is to be washed out thoroughly with cold water. The nutrient injection should not be given oftener than once in six hours, and if the bowel is irritable, not oftener than once in twelve hours. The absorptive power of the rectum is slight, but that of the colon is considerably greater. Predigested food is most valuable. Leube's Beef Peptone may be used. A bullock's pancreas is finely chopped and rubbed up with eight ounces of glycerin. This extract will keep fresh several weeks in a cold place. To one-third of the extract are added five

ounces of finely chopped beef, and the mixture is ready for immediate use. The peptonizing powders of Fairchild Brothers & Foster are most convenient in preparing digested food. Each powder consists of five grains of pancreatic extract and fifteen grains of sodium bicarbonate.

A useful nutrient enema for a large dog may be made of two eggs and six ounces of milk. Four to six eggs may be added to a quart of milk for use as an enema for a horse. The mixture is then to be peptonized and introduced into the rectum at the temperature of the body. In using the peptonizing powders, one is placed in a quart glass jar together with a teacupful of cold water. Then a pint of the mixture to be peptonized is poured into the jar, and the latter placed in a vessel containing water as hot as the hand will easily bear. The jar is kept in the hot water for twenty minutes and put on ice. When the mixture is used it should be heated to 100° F. If predigested food is to be given by the mouth, it is well not to keep the glass jar immersed in hot water more than five minutes, as otherwise the taste will be bitter and disagreeable. A small dose of laudanum is always useful to prevent the expulsion of enemata. Brandy may be added in the proportion of one ounce to the pint of milk after peptonizing. The addition of salt to egg-albumin greatly facilitates absorption. Panapeptone and brandy, each one ounce, in six ounces of normal salt solution form a good substitute for the peptonized milk enema. Gruels of all kinds, and broths, may be peptonized, as well as milk. It is not essential, however, to peptonize milk and other fluids, although absorption is rendered somewhat more complete. The digestive powers of the large intestines are but slight. Sugar is absorbed unaltered; undigested proteids (with certain exceptions) and fat are not absorbed. Peptones, soluble proteids, as milk, meat juice, egg albumen, and emulsified fat are absorbed. Nevertheless, absorption from the lower bowel is trivial compared with that from the small intestines generally, and as the extent of surface with which rectal injections come in contact is small, and their sojourn short, it follows that rectal feeding cannot take the place of normal alimentation.

In tetanus, paralysis of muscles of deglutition, fracture of the jaw in horses, persistent vomiting and convulsions in dogs, and in all animals refusing food, rectal feeding is indicated. It is possible to feed animals through a stomach tube (or catheter), and, in hospital cases, this method may be preferable.

Counter-Irritants.

A counter-irritant is an irritant which acts counter, or against an existing irritation, result of irritation, or pain. In applying a "twitch" to a horse, we are inflicting an irritation to relieve some other source of irritation elsewhere. It is taken for granted that the damage and pain caused by the artificial irritant are not so severe as those already existing. The amount of injury produced by an irritant depends upon the nature of the material, its strength, the duration of its action, the mode of application, and the part to which it is applied. We may consider the effects occasioned by a mild and increasing action following the continued use of a single agent, or representing the action of materials of different degrees of potency. There first appears redness of the skin, accompanied by some burning or pain (rubefacient action), and if the irritation progresses there is a serous exudate poured out into the mucous layer of the skin. This leads to swelling and edema. Greater irritation causes more exudation of serum and an elevation of the epidermis in a circumscribed area or areas, and the formation of blebs or blisters (vesication). If the irritation ceases at this point, the blisters break open and their contents dry on the surface, covering the parts with a thick scab. Synchronous with vesication we observe a similar process attacking the hair follicles. The hairs are loosened and fall, but as the papillæ are usually unaffected, the growth of hair is soon renewed. The recovery of hair is facilitated by the application of grease to parts. Certain agents cause circumscribed inflammation of the gland orifices of the skin, with the formation of pustules (pustulants), as croton oil, and these create necrosis of the hair papillæ, and, therefore, permanent loss of hair. If the irritant is severe, suppuration follows vesication; or, if an ordinary irritant is applied with violent friction, is covered with a bandage, or placed over an already inflamed part, the same result happens. The terms referring to the degree of action inherent in agents are as follows:

1. A rubefacient, causing hyperemia.
2. A vesicant, or epispastic, inducing blistering.
3. A pustulant, creating pustules.
4. An escharotic, or caustic, occasioning death of the tissues.

The same agent, as has already been pointed out, may produce one or more of these actions according to circumstances. The inner aspect of limbs and the flexures of joints are peculiarly sensitive, owing to the thinness of the skin over these areas. If a counter-irritant is rubbed properly into the skin it may penetrate into the mucous layer.

Reference has been made to the local influence of irritants. We will now direct attention to their remote effect. It is certainly known that irritation of the surface decidedly affects distant organs. Brown-Séquard noted contraction of vessels in one arm when the other was immersed in cold water. Severe burns of the surface are followed by duodenal ulcers. The preceding and succeeding remarks enable us to partially account for the remote influence of counter-irritants, but although we know their practical value, it is not within our present knowledge to offer theories wholly explaining their effect.

The influence of counter-irritants may be summed up in reflex action; *i.e.,* the production and conduction of an impulse from the periphery to nerve centres, thereby modifying the nerve functions and blood supply in distant parts.

The skin is commonly the point of application. It normally is an organ of protection, respiration, secretion and special sense, and, through its medium, a regulator of temperature, responding to such natural stimuli as heat, cold, moisture and dryness. Such an unnatural and considerable stimulation as is produced by counter-irritants consequently creates very sensible alterations in the bodily functions. Extensive counter-irritation causes the breathing to become slower and deeper by reflex stimulation of the respiratory centre, and also by making the respiratory movements more painful, if the application be made to the chest wall. The circulation is likewise affected by stimulation of the vagus and vasomotor centres, and both the force of the heart and blood pressure are increased, unless the irritation is very widespread and severe, when the reverse happens. The abdominal vessels are those constricted; the vessels of the skin and limbs are unaffected. In accordance with the foregoing remarks, the use of considerable heat, together with mustard or turpentine, is of great value in conditions of vital depression, surgical shock, collapse and coma. Moreover, the effect on local blood supply is still greater and full of importance, since it may explain the beneficial action obtained in the ordinary use of counter-irritants. In experiments conducted upon animals, it has been observed that when sinapisms are placed over the head, the blood vessels in the pia mater are first dilated, but soon contract and remain in that condition for some time. Likewise there was seen, following energetic counter-irritation of the chest, anemia of the underlying parts, including the muscles, pleura, and even the pulmonary tissue. It is essential to bear in mind, then, that while counter-irritants induce local congestion in their immediate vicinity, they also cause reflexly vascular contraction in more remote areas. In accordance with this demonstration, the importance of these agents in remote inflammation lies not so much in their bringing blood to the surface, as in forcing it out of

distant parts. This fact is not generally appreciated. The use of the word "drawing" signifies the common idea of a counter-irritant, and implies the first proposition.

Temperature is not materially affected by the therapeutic use of counter-irritants, and they are not necessarily contraindicated in fevers. Experiments, however, appear to show that mild counter-irritation may lead to a slight elevation of body-heat, owing to stimulation of the calorifacient centres, while extensive and prolonged action lowers temperature by depression of the heart and heat centres, and because more blood flows through the peripheral vessels owing to constriction of the vessels in the abdominal organs.

Counter-irritants notably relieve pain. This result is not only due to overcoming congestion, but occurs when pain is purely neuralgic. The phenomenon is not altogether explicable. The subduing influence of a twitch in the case of pain inflicted upon a horse is an analogous example. Wechsberg, in some late experiments, notes, as a most striking effect of counter-irritants, edematous infiltration of the skin, subcutaneous tissue and muscle in sub-adjacent parts, with compression of blood vessels in the deeper-lying structures. He attributes the relief of pain afforded by counter-irritants to anemia and rapid compression brought to bear on the nerves in these underlying parts.

Still this explanation does not interpret the relief of pain sometimes seen in parts remote from the point of application of counter-irritants.

In disease of internal organs Head has constantly found certain corresponding areas of skin tenderness. This because both the internal organ and the skin area are innervated from the same segment of the brain or cord. Theoretically and practically counter-irritation of a skin area affects the internal organ corresponding (by nervous connection) to this area more than other parts. These areas of skin tenderness for diseased internal organs, and for application of skin irritants to relieve these conditions, have been mapped out in man. In the case of the chest and belly they are situated pretty nearly over the site of the internal organ. In the head the sensitive skin-sites are not over the diseased part.

Pain is usually referable to the peripheral ends of an affected nerve. It is good practice to apply counter-irritation directly over a deep-seated inflammation or seat of pain (see above), but in assuaging superficial pain it is found, that where the treatment can be made over the root of the painful nerve, better results are obtained. In pain in the chest wall a blister should be placed next the spine over the root of the spinal nerve involved; in pain in the head in man, counter-irritation is applied over the back of the neck. Counter-

irritation should be done over the temple, in pain in the eye (iritis); behind the ear, for pain in that organ.

In the treatment of enlarged glands and in acute inflammations, as abscess, boils and carbuncles, by counter-irritants, the application should be about the lesions rather than directly upon them.

Among other actions accomplished by counter-irritants are: possible stimulation of trophic nerves and nutrition of a part; augmentation of tissue change, locally and generally, and dilatation of vessels (when applied after the subsidence of acute inflammation or in chronically inflamed parts), with renewed activity of the circulation and consequent absorption of inflammatory exudations. The local action of skin irritants increases the leucocytes and opsinins in the inflammatory area (acted upon) and leads to bacterial destruction. The toxins are also more rapidly removed by their influence. Furthermore, counter-irritants reflexly overcome spasm and pain occurring in colic, by stimulating and replacing normal peristaltic action in place of abnormal localized contractions. In like manner they excite uterine contractions by stimulation of the involuntary muscular fibres of the womb.

INDICATIONS FOR COUNTER-IRRITANTS.

1. To overcome congestion and inflammation in remote parts.
2. To promote absorption of inflammatory products locally.
3. To relieve pain.
4. To stimulate the heart, respiration and nervous functions.

Rubefacients.—In this class are included the volatile oils—turpentine, oil of wintergreen, etc.—alcohol, chloroform, balsams, resins, iodine, tincture of camphor, tincture of cantharides, mustard, and heat. These agents are used when it is desirable to stimulate the nervous system rapidly, and to relieve pain and congestion. To attain this end, we employ comparatively mild agents in order that we may apply them over an extensive surface without causing serious or permanent results. Mustard is rubbed with warm water into a thin paste (a sinapism), and rubbed over the chest of horses in congestion of the lungs, in acute bronchitis, or in the first stage of pleuritis, to obtund pain and lessen congestion. Sinapisms also relieve obstinate cough, revive failing respiration, and stimulate reflexly the vital functions in collapse, shock and narcotic coma. Applied over the cardiac region, they avert syncope. To assist the action of mustard, we often cover the application with hot blankets, and then with dry ones. Stimulating liniments are sometimes preferred. One volume of oil of mustard may be combined with fifteen volumes of oil of turpentine; or ammonia water, thirty parts, and

oil of turpentine, fifteen parts, are added to spirit of camphor and soap liniment, each fifty parts.

Turpentine is more valuable in abdominal disorders in horses. It is sprinkled on hot blankets, and applied as a stupe to stop pain, spasm, and stimulate normal peristalsis in colic; and to relieve pain and congestion in enteritis, peritonitis, diarrhea and other difficulties. The beneficial result accruing from the use of external counter-irritants in bowel troubles is often facilitated by the injection of hot (115° F.) rectal enemata.

Stimulating liniments are serviceable in aiding resolution of swelling following the acute stage of cellulitis, lymphangitis, neuritis, mammitis, rheumatism, strains and bruises. They are often employed in laryngitis. In chronic skin diseases, as eczema, mild counter-irritants (tar, oil of cade, Peruvian balsam, etc.) substitute an active reparative process, tend to aid absorption of exudation and induration, and relieve pain and itching. The tincture of iodine may abort incipient inflammatory lesions, as boils and abscess, by means of its counter-irritant and antiseptic properties.

VESICANTS AND THE ACTUAL CAUTERY.

Cantharides, red iodide of mercury, and croton oil, are more commonly used in veterinary medicine to cause blistering. Reference will be had, hereafter, to cantharidal blisters. Blisters and the cautery are especially indicated to cause resolution of inflammatory products and modification of inflammatory processes; to secure fixation and rest of parts, and to relieve pain. It is impossible to enumerate all the conditions in which they are useful. In the treatment of severe sprains, as curb and "breakdown"; and in exostoses, as ringbone and spavin, the actual cautery (firing) is used before and in conjunction with blistering to exaggerate the counter-irritant effect. Absorption is attained in the foregoing conditions by the production of an acute inflammation, with increase of vascularity, tissue change and fatty degeneration. In "breakdown," the formation of scar tissue is thought (without reason) to assist in supporting the limb. Sometimes, on the other hand, osseous deposit is unabsorbed, but anchylosis and freedom from pain in a diseased joint is secured by the enforced maintenance of rest and fixation of the joint, together with the production of new bone.

In exudative diseases of serous membranes, as pleuritis, pericarditis, peritonitis, meningitis, arthritis, and synovitis, blisters facilitate absorption and recovery after the acute stage is over. This favorable result is not due to loss of serum, but to modification of the inflammatory process. In the first three diseases named above.

blisters—flying blisters—may be applied in spots every few days in different places over the affected area.

Blisters reflexly stimulate the nerve centres in meningitis, in addition to their action on the inflammatory lesion. They should be applied over the poll or spine according to the location of the trouble. Absorption in chronically enlarged glands is assisted by blisters. They also hasten "ripening" of suppurating glands or abscess when this process is slow, and hasten their resolution after evacuation of pus. The blister should be rubbed on about the inflamed area in these lesions.

Vesicants are also valuable in pharyngitis and laryngitis for severe cases, when stimulating liniments are ineffectual; and, in lessening pain, exudation and swelling of the throat, may avert the necessity of tracheotomy. A blister applied about the coronet in diseases of the feet is serviceable in stimulating the growth of the hoof and promotes repair in navicular disease, laminitis, and cartilaginous quittor, after the acute stage is passed. In arthritis and synovitis, the whole diseased area, with the exception of the flexure of the joint, is covered with a blister. Since it is often impossible to immobilize a part, in veterinary practice, by splints, blisters are sometimes employed for this end after reduction of dislocations.

The hair should be clipped from an area to be blistered, the skin washed with soap and water, and the animal tied up or restrained in some way from biting the part. It is the custom to cover immediately the surrounding parts with grease, but protection from the acrid discharge can be secured more effectively by frequent sponging with soap suds and water; or painting the skin, under the blistered surface, with a solution of rosin in alcohol. Grease is not so good a protective, since it is a solvent for cantharides. Vaseline should be applied following the active stage.

Caustics or Escharotics are agents which destroy tissue. They comprise such substances as the caustic alkalies, mineral acids, silver nitrate; iron, zinc and copper sulphates; ferric, zinc and mercuric chlorides; carbolic acid, arsenic, together with the actual cautery. They are indicated in the treatment of exuberant granulations, morbid growths, septic, sloughing and necrotic parts, pyogenic membranes, fistulous tracts, and for the destruction of poisons, as in rabid dog and snake bite. Escharotics stimulate and modify nutrition in unhealthy wounds and ulcers. Many form chemical compounds with the tissue elements. Heat oxidizes animal tissues, and also coagulates albumin and abstracts water from them.

The alkalies produce greasy compounds with the proteids, saponify the fats and withdraw water from the tissues. They are the most widely destructive agents. Silver nitrate forms an in-

soluble albuminate with the tissues to which it is applied, and protects the underlying structures from further action. It is most superficial in its action, but possesses specific properties in altering the condition of unhealthy wounds for the better. Extreme heat, exemplified by the white-hot iron, acts as a counter-irritant in stimulating reflexly the nervous system; in increasing the vascularity of surrounding parts, and in favoring revulsion of blood; in aiding absorption and resolution, and in relieving pain apart from its direct destructive effect. Caustics may be applied in either the solid or liquid state, and in various forms, as the stick, powder, paste and ointment. Caustics are sometimes employed to stop hemorrhage. The reader is referred to articles on special agents for further details.

Suppurants.—Any of the more active counter-irritants, as croton oil, may induce suppuration. Under this head may be mentioned setons and issues of rowel. A seton is a piece of tape or other material, introduced through an incision in the skin and thence under the skin in the connective tissue, and finally out through the skin at a short distance from the point of entrance. The loose ends are then knotted together, and the whole loop is drawn through the wound once daily to keep up constant irritation and suppuration. An issue of rowel is a piece of gauze or tow, which is passed into an incision, where the substance remains, and causes continual irritation and suppuration. To intensify their irritant action, both setons and issues of rowel may be first saturated with cantharides ointment or oil of turpentine. They have been employed in acute disease of the eye, meningitis, "strangles," and in joint and shoulder lameness, near the seat of trouble. Setons and issues of rowel are barbarous and dirty, and fortunately have become obsolete.

Cold and Heat.

Cold.—Cold and heat are only relative terms. As used here, they refer, respectively, to a thermal intensity below or above that of the body. Cold is usually applied by means of water in some form. In veterinary practice we are limited in the employment of cold air, as a medium, to the use of free ventilation and protection of animals from the solar heat.* Cool air is especially desirable in the treatment of most febrile affections by lowering temperature and serving as a stimulus to the respiratory, circulatory and nervous func-

* The cold air treatment—of pneumonia, especially—is now exceedingly popular in human medicine. The patients are kept outdoors even in the coldest weather under shelter and well-covered. Reduction of fever and stimulation of the vital centres are among the chief advantages accruing. The same treatment applies to animals. In pneumonia of horses an abundance of fresh, cold air should be secured with the animal well blanketed and the limbs bandaged.

tions generally. Locally, cold causes contraction of the peripheral vessels and muscles of the skin, forcing out fluids from the part and reducing local temperature. This is more distinctly noticeable in congested areas. If the application is very severe or long continued, the vessels lose their tone, become paralyzed, and we have passive congestion, inflammation, and finally death.

Ordinarily, reaction sets in after the use of cold, more particularly if followed by heat, when an active hyperemia is substituted for the ischemia. This is brought about both by reflex stimulation of the heart by the cold, and local dilation of the vessels. Therefore, when we wish to constringe parts, we use moderate cold continuously; but, by alternating cold and heat we may accelerate the blood supply, and by first forcing out, and then bringing back the fluids of the tissues, we can maintain such an activity of the circulation that even solid exudations are absorbed. Cold, locally, lessens nervous irritability and pain directly, and, also, by contracting the afferent vessels, it diminishes the impact of the blood on sensitive parts. Moderate heat is said, nevertheless, to produce much the same result by relaxing the capillaries of the collateral circulation, thus draining off the blood and relieving tension in the inflamed part. Tissue change is diminished, locally, by the action of cold. Suppuration and sloughing proceed but slowly under its retarding influence. Acute abscess is converted into what might be logically termed a "cold abscess" in the most literal sense of the word. Remotely, moderate cold applied to the body for a short period actually increases general temperature by stimulating reflexly the heat centres, increasing oxidation and lessening radiation from the contracted superficial vessels. If cold is in contact with the whole body for a longer time, the temperature gradually sinks and the reduction continues for some hours when, in healthy animals, the temperature rises above normal. Such effects are much more pronounced in pyrexia. The action upon the nervous system is exceedingly important therapeutically. The most powerful stimulating action is exerted upon the centres of innervation controlling the circulatory, respiratory, digestive and excretory organs. In fever, this treatment invigorates the failing digestive functions, relieves the nervous irritability by cooling the blood going to the great nerve centres in the medulla, and strengthens and stimulates the entire nervous organization. Cold applications and drinks stimulate the circulation reflexly, increase blood tension, and, therefore, the secretion of urine in fever, which is very important for the elimination of toxins. Locally, heat and cold are often used interchangeably in medicine. In human practice it is a rule to be guided in the choice of one or the other by the desire of and effect upon the patient, and this should apply, as far as possible, in veterinary practice.

Cold is employed, locally, in congestions of superficial parts, and tends to abort inflammation and relieve pain.

In meningitis, rubber ice bags or continual irrigation of the head and spine are used. Laryngitis may be successfully treated by ice poultices (cracked ice and sawdust in linen bags) or by thin rubber ice bags surrounding the throat. In the same way are treated sprained tendons, capped hocks, broken knees, recent curbs, and lymphangitis. In fact, most superficial inflammatory surgical affections are benefited by cold applications. Ice and ice water are useful in checking venous or capillary hemorrhage, although hot water is often more serviceable. Cold water enemata are valuable in atonic constipation, diarrhea, and to reduce temperature in fever. In the uterus, ice in small lumps will arrest metrorrhagia, and, in the rectum, aid in reducing prolapse. Ice bags, placed along the spine over the sympathetic ganglia, will cause dilatation of arterioles in regions corresponding to the point of application.

MODES OF EMPLOYING COLD WATER.

Ablution is the simplest method of applying water to the surface of the body. It is merely bathing. Water at the temperature of 50° to 60° F. is applied by a rough, coarse cloth. The water is thrown on in considerable quantities, beginning with the head and going rapidly over the neck, trunk and limbs successively, rubbing the skin briskly all the while with the cloth. Two attendants are required for the application of an ablution to the larger animals. The patient is finally dried and warmly blanketed. The process may be repeated each half hour in fever, or twice daily as a tonic measure in chronic diseases. The rationale consists in the stimulus afforded by the cold to the nervous system, accompanied by contraction and subsequent dilatation of the peripheral blood vessels, with consequent cooling of the blood and increased radiation of heat from the surface. In most hydriatic methods for reducing temperature in fever, friction of the skin should be the *sine qua non*, as otherwise the physical cooling of the body is confined entirely to the periphery, the contraction of the surface vessels driving the blood inward to the vital organs. The superficial muscles then act as non-conductors, and heat production being stimulated reflexly by the cold, an actual increase of internal temperature may obtain.

It is only by securing dilatation of the superficial vessels by friction that the result first described can be prevented, for after the first shock the peripheral vessels dilate, an increased supply of blood is brought to the surface, is rapidly cooled and courses inward, only

to be replaced by more over-heated blood. The internal temperature is thus lowered, and instead of an internal congestion being brought about, as may happen when the skin is simply exposed to cold, we have a constant withdrawal of heated blood from the interior. In this perpetual interchange not only does cooling of the blood and body occur, but the circulation is equalized and congestions are overcome.

The Sheet Bath.—Whole baths are impracticable for our larger patients, and the sheet bath may be substituted to advantage for antipyretic and other purposes to which the cold bath is adapted. A cloth soaked in cold water, or ice poultice, is placed on the poll to prevent determination of blood to the head, and a linen sheet, wet in water, of from 50° to 80° F., is placed over the animal, the surface being rubbed, while dashing on the sheet water at the temperature of 50° to 60° F. This process is continued for fifteen or twenty minutes, unless rigor is induced. The method is valuable in the treatment of fever and insolation. The general rationale is the same as in the case of ablutions, but the antipyretic effect is more marked and permanent. The sheet may be covered, while wet, by blankets, and converted into a wet pack.

The Wet Pack is applicable for general or local use, and for various purposes. A linen sheet is dipped in water at a temperature of 50° to 70° F., and wrung out very thoroughly. A cold application is put on the head and the sheet applied and covered with dry woolen blankets. The duration of application is from one quarter to three hours, according to the object in view. If it is used as a strictly antipyretic measure, it should be changed frequently. The wet pack differs materially from other hydriatic procedures in that reaction occurs slowly, for there is no artificial stimulus in the shape of friction to accelerate it. The primary contraction of the vessels is succeeded by partial dilatation of them, when the blood from the interior of the over-heated body is cooled on the surface by contact with the sheet and by vaporization of the water. Vascular contraction again occurs owing to the cooling, forcing the chilled blood inward. So there is continual interchange of cooled and heated blood, until the wet sheet has become thoroughly warmed. After the wet pack is removed, the skin should be dried and the patient well blanketed.

The interchange of blood is useful in relieving congestion of the internal organs, in aiding nutrition by bringing to the periphery nutriment absorbed from the gastro-intestinal tract, and for its tonic effect on the nervous system. In fever, it abates cerebral hyperemia, delirium and excitement, and promotes rest and quiet.

*The Priessnitz Poultice** is similar to the wet pack, but a waterproof protective is interposed between the wet blanket, sheet, sponges or cloths on the inside and outside woolen coverings. Evaporation is thus prevented, but not vaporization. Such an application may be used with safety in febrile diseases, as pleuritis and pneumonia. If it is not renewed frequently, hyperemia of the surface occurs, and this may be beneficial in aborting or relieving internal congestion. It then acts as an ordinary poultice, and is of value in various local inflammations resulting from strains, blows and bruises; also, in laryngitis. Besides relieving internal congestion, the Priessnitz poultice stimulates absorption, removes induration and hastens suppuration, locally. The wet pack and Priessnitz poultice are more appropriate for practical use than the other methods in veterinary practice, since the evaporation from the hair of animals contraindicates methods suitable in human medicine.

Cold Baths are only practicable for the smaller animals. Dogs may be immersed in water at 90° F., which is rapidly cooled down to 60°. The bath should last about fifteen minutes, the surface of the body being rubbed constantly. Ice water should be frequently poured over the head. After removal from the water, the patient must be thoroughly dried, wrapped in warm blankets, and a stimulant given if necessary. Such treatment may be used as an antipyretic measure if the temperature is over 103° F. in the rectum.

Douches.—A douche is a forcible impact of water against the surface of the body. It is not used for its antipyretic effect, but acts as a stimulant to the nervous system at large, whereby the respiratory action is deepened and strengthened, and the circulation invigorated. The douche is given advantageously in the treatment of coma, of alcohol, chloroform, ether or opium, applied to the head. The water may be dashed from a pail or applied by means of a garden hose or from a tap. Rheumatic lameness and peripheral paralysis are suitable cases for the douche treatment, followed by vigorous rubbing and dry bandaging. Syncope may often be quickly relieved by douching of the head and chest.

Local Baths are good, especially in inflammatory conditions of the feet in horses. Tubs may be employed for the animals to stand in, the water being changed frequently or being kept cool by ice. It is not advisable to allow animals to stand in large bodies of water on account of the danger they incur of "catching cold" from surface evaporation. The value of the local use of water in acute laminitis

* The Priessnitz'scher umschlag (poultice) of the Germans is often defined as a cold water compress, without waterproof covering. It must be renewed frequently, as it soon dries. Its effect is cooling and not as a poultice in supplying moist heat, and it does not aid phagocytosis

is worth mentioning here. After the shoes have been removed the extreme pain may be alleviated by standing the horse in quite hot water, sufficient to reach up to or above the fetlocks. Good results are obtained by changing to ice water after the first day and continuing this for several days, in this way causing a contraction of the arteries, lessening the amount of blood supplied to the part and the danger of chronic laminitis and dropped sole. If convenient to a running stream, about the same results may be obtained by standing the animal in it.

Irrigation with cold water is done in inflammatory diseases of the joints, tendons and feet. Running water may be permitted to flow continuously through perforated rubber tubes, connected with a tap, or used as siphons and closed at their distal extremities. The holes may be made in the tube with red-hot needles. The rubber tubes should be wound about the limb or part and held in position by bandages. Leiter's expensive block tin tubes are easily bent and rendered useless by the movements of our patients. The treatment of lacerated wounds by means of a stream of water from a convenient hydrant, causes the part to granulate quickly and greatly facilitates the healing process, but care should be taken not to allow the water to run over the wound more than three or four hours at a time each day, otherwise the part will become "waterlogged" and tend to break down and slough rather than to fill in with healthy granulation tissue.

Cold Drinks are both refreshing and antipyretic in action. Cool water should be placed where the patient can take it as he desires. In stomatitis, tetanus and angina, cool water is distinctly grateful and comforting. In the latter two diseases, it should be arranged so that the animal can reach it without bending the neck. The mouth can be rinsed out continually, removing decomposing food and mucus, the thirst be slaked and heat and inflammation relieved.

Cold Enemata are valuable antipyretic agencies. From five to fifteen quarts of cold water may be thrown up through a flexible rubber tube, six feet long, far into the bowel of the horse.

Evaporating Solutions.—Ethyl chloride or ether spray may be applied for a short time by means of an atomizer, to induce local anesthesia of a part, through the powerful refrigeration produced in their evaporation, and is most satisfactorily employed in conjunction with cocaine injections. One turn of a cotton or linen bandage, or a single thickness of similar stuff, put about a part and wet continuously with cold water, forms a good evaporating medium in allaying superficial inflammation and pain. A mixture of clay, and equal parts of water, vinegar and diluted solution of lead acetate,

make a cheap and efficient cooling application for external use in the treatment of bruises and sprains. The paste should be removed as quickly as it dries.

Refrigerants.—Certain medicines either produce a subjective feeling of coolness or actually cause it, applied externally or given internally. The subjective sensation is due to some inexplicable action on the local nerve supply. Some are stimulants and astringents, and diminish the circulation in the part. Externally, acetate of lead, chloride of ammonium, nitrate of potash, and vinegar, are used most frequently as refrigerants.

The mineral acids and salts of potassium and sodium, especially potassium nitrate, are administered more commonly, internally, both for their cooling effect and to allay thirst.

HEAT.

Water at a moderate degree of heat—what is termed lukewarm —*i.e.*, 86° to 95° F., applied to the body, stimulates the action of the skin, relaxes peripheral vessels and diminishes nervous excitability, pain and spasm in neighboring parts. Water at a temperature of 112° to 120° F. contracts blood vessels of underlying parts, relieving congestion and pain. Such a degree of heat resembles cold in its effect, and they may often be used interchangeably. Still stronger heat has much the same effect as excessive cold, only acting more quickly, causing dilatation of the vessels, pain, inflammation and destruction of tissue. The action of powerful heat on the whole body, or upon single organs, is similar to that of counter-irritants. Mild, moist heat is beneficial in the treatment of wounds in poorly vascular parts where there is a tendency to indolent granulation, as about the feet in horses; Again, in low grades of inflammation with induration, as in strains of tendons, where moderate heat tends to stimulate the circulation and hasten absorption. In the treatment of abscess and burns, with destruction of tissue and suppuration, moist heat applied locally macerates the dead tissue, hastens sloughing and relieves pain, and in softening parts prevents the burrowing of pus and the formation of deep-seated pockets and sinus's.

A modern view of poulticing is that it aids the migration of leucocytes, and therefore is productive of good in assisting their phagocytic action. Hot applications increase exudation, congestion, collection of leucocytes and opsinins, locally. All these results are inimical to bacterial growth. The abscess can thus be more speedily formed and more quickly defined. Herein heat differs from cold. In irritable and spasmodic troubles of muscular origin in various

organs, heat is distinctly remedial, as in pelvic and abdominal pain and colic, when employed in the form of rectal injections. Heat may, in many conditions, be used interchangeably with, or in the place of, cold, according to the preference of the practitioner or the effect upon the patient. As, for instance, in the case of pneumonia, pleuritis, angina, and in checking hemorrhage. Heat may be utilized in simply preventing the natural radiation of it from the body. Thus, simple, warm, dry blankets, applied all over the surface of the body, may abort catarrhal or rheumatic conditions by merely causing retention of the body heat, dilatation of the peripheral vessels and equalization of the circulation. Covering a portion of the skin with such dense preparations as tar, pitch or collodion, in mild superficial inflammatory lesions, is said to produce favorable results by restraining radiation and increasing heat and blood supply in the part. Even thickened tendons and indurated glands may be benefited thereby. The Priessnitz poultice continuously applied has a similar action. In vasomotor paralysis, seen in collapse, following loss of blood or poisoning, and in shock due to traumatism or surgical operation, heat is eminently a life-saving means. In such conditions the loss of vascular tone and dilatation of the vessels lead to dangerous, and even fatal, cooling of the body. Heated dry blankets, or those wrung out in hot water, should be applied to the larger animals, together with hot rectal injections; while the smaller animals may be placed in baths at the temperature of 105° F., till the temperature becomes normal. Such treatment should be combined with the use of vascular and cardiac stimulants, camphor, adrenalin, atropine, digitalis and strychnine, and saline infusions.

MODES OF APPLYING HEAT.

*Poultices or Cataplasms.**—Cataplasms are compositions for the local application of heat and moisture. They are made, commonly, of flaxseed meal, bran, oatmeal, bread, potatoes and carrots. One or other of these is stirred up in boiling water until a thick, pasty consistency is reached. This mass may then be applied, while very hot, directly to the part when we wish to produce a softening of the tissues, as in abscess or tender feet in horses, and the whole is covered by a cloth. In poulticing horses' feet, the material—usually bran and flaxseed meal, equal parts—is mixed in a pail, with boiling water, and spread on a piece of bagging (double thickness, and about two feet square), in sufficient quantity to surround and cover

* Cataplasma Kaolini (U. S. P.) consists of kaolin, or porcelain clay, and is applied externally as a poultice. It acts to retain the body heat and is very similar to "Antiphlogistine," an excellent substitute for the ordinary poultice.

the entire foot. The bagging is then folded and tied about the pasterns, and over around the front and sole of the foot. The whole should occasionally be immersed in water to prevent drying of the poultice. When a poultice is used merely for its continued heat, in relieving heat and congestion, the material should be enclosed in a flannel bag, in order the longer to retain and radiate its warmth.

A very hot poultice acts as a counter-irritant in contracting blood vessels in more remote parts, besides its effect in abating pain. A warm, moist poultice causes a mild local hyperemia, softens broken down and dead issues, and aids suppuration and sloughing. Poultices are not employed very much, except in the treatment of horses' feet, as they are clumsy, laborious contrivances, and difficult to keep in place. If long-continued, they cause tissues to become swollen, sodden and macerated, destroying their vitality. Antiseptic poultices are made by soaking sheet cotton, gauze or other absorbent material, in hot antiseptic solutions, as corrosive sublimate, 1-1000; creolin or lysol, 1-100. The material is very lightly wrung out, wrapped about with dry gauze, covered with oil paper, silk or rubber protective, and applied to the part with a bandage. Antiseptic poultices are useful in the treatment of septic injuries, and when there is much pain, destruction of tissue, sloughing and suppuration. Otherwise, poultices are decidedly contraindicated in the case of wounds, as dry antiseptic or aseptic absorbent dressings are far preferable in securing one of the cardinal requirements in the process *of healing, i.e.,* dryness. As substitutes for ordinary poultices, we have spongio-pilene, counter-irritants, stupes and fomentations. Spongio-pilene occurs in sheets, about an inch in thickness, made of a mixture of sponge and felt, backed with a flexible covering of gutta-percha. Its main objection is the expense. It forms, when soaked in water, a cleanly and easily applied poultice for non-suppurating parts.

Counter-irritation, as has been pointed out, is produced by hot poulticing as well as by drugs. A combination of the two is obtained in stupes.

Stupes, Stupa.—A stupe consists of a flannel or other cloth, wrung out in plain or medicated hot water, and applied to the skin. These are often covered by waterproof protection, the better to retain heat. In the veterinary art, hot blankets are often applied over the whole chest or abdomen to relieve internal congestion and pain in pleuritis, pneumonia and colic. Turpentine stupes are more in favor with abdominal troubles. These are made by simply sprinkling oil of turpentine over the hot blankets, or by saturating flannel cloths in turpentine and wringing them out in very hot water. To get a very

active counter-irritant effect, a mustard paste may be rubbed over the chest, and then hot blankets applied.

Hot Water Bags, made of rubber, and enclosing water at a temperature of 120° F., may be placed along the spine, and by stimulating the cord and sympathetic ganglia, cause stimulation of vaso-constrictors in regions corresponding to the controlling areas over which the heat is applied. In this manner inflammatory conditions of the throat, chest, and abdomen are said to have been aborted, and internal hæmorrhage effectually arrested. Conversely, cold may be used over the spine to dilate distal arterioles.

Fomentations are simply local baths. As technically employed, the word refers to bathing parts with plain or medicated hot water, by means of sponge or cloths. They may be used to cleanse wounds or parts of dried discharges; they act as counter-irritants if very hot, or as mild, stimulating, soothing and softening applications if warm. In order to produce much effect, besides a mere detergent one, they should be applied for a considerable length of time—one half hour at least—and be followed by drying and bandaging. Fomentations reduce swelling and pain, and hasten repair in bruises, strains and local inflammatory lesions.

Injections of hot water are employed to cleanse wounds, stop bleeding and relieve pain and spasm. Injections may be thrown into the rectum or vagina at a temperature of 115° to 120° F. In the vagina, hot water may stop postpartum hemorrhage, pain and congestion in the pelvis, by producing uterine contractions, and atonic constriction of vessels in neighboring parts, which lasts for several hours following its use. Hot rectal injections (115° F.) subdue abdominal and pelvic pain or spasm, as intestinal or renal colic and spasm of the neck of the bladder. The heat *per se* in such injections may be invaluable in shock and collapse as noted above.

The water may either be led off through a rubber tube, from a stop-cock in a pail or reservoir, placed above the patient, or else siphonage may be done off-hand through a bit of small-sized hose. Having hung a pail filled with water one or two feet above the patient, the hose is filled with water, and, closing the ends to keep it full, the upper part is put in the pail, while the lower, smooth and greased, is passed into the rectum or vagina; or water may be poured through a large tin funnel into the upper end of the tube. The ordinary fountain syringe is the best apparatus for smaller animals.

Dry Heat may be applied by means of hot blankets, hot water bags, hot salt or sand in cloth bags, a flatiron or hot, wet cloths between waterproof coverings. Dry heat is often preferable to moist heat for simply relieving pain and congestion, as animals are less

apt to become chilled by drafts and evaporation from the surface afterwards. It is generally more difficult to obtain, however.

Inhalations of plain or medicated steam are given for their local effect on the mucous membranes of the upper air passages. The moist heat has a soothing action on the nerves, and tends to loosen dry exudations. Agents may be incorporated in the inhalation having a sedative, stimulating or antiseptic action. (Vid. "Agents Acting on the Respiratory Organs," pp. 41, 42.)

The technique consists in placing a bucket containing a boiling mash under the horse's nose, or in pouring cool water over a heated brick or iron in the bottom of a pail. The practice of tying a bag over a horse's head, and steaming him therein, is bad, if the animal is suffering from respiratory troubles, as insufficient pure air is obtainable. A dog may be placed on the seat of a cane bottomed chair, and covered loosely with a sheet over the whole, the steam being generated in a vessel beneath.

Hot Baths at a temperature of 98° to 110° F. are impracticable for larger animals. They can be given to the smaller animals in collapse, shock, rheumatism, and to abort cold after exposure. Glowing heat is applied by means of heated metal, and is treated under the section on counter-irritation.

ACTION OF HEAT CONTRASTED WITH THAT OF COLD.

The action of intense heat or cold on animal tissue is very similar in effect, producing vasomotor paralysis, congestion, inflammation, destruction of tissue and death. Even the sensations to which they give rise resemble each other so closely, that coolies on first handling ice said they could not hold it because it burned their fingers. Strong heat (115° to 120° F.) contracts blood vessels in underlying parts and overcomes pain and congestion. Heat of this degree approaches cold in similarity of action. A moderate degree of heat dilates vessels, while cold of like intensity contracts them. Moderate heat relieves pain by relaxing tissue, diminishes vascular tension by dilating efferent vessels of the collateral circulation, and draining off blood from the congested areas. Moderate cold, on the other hand, accomplishes a similar result in benumbing nervous sensation and lessening the impact of blood in the painful region by constringing the afferent vessels. Tissue change is increased by moderate heat, but decreased by cold applied locally, or generally in fever. Swelling of tissue is reduced by cold directly; only indirectly by heat, which may, indeed, increase it. Softening and sloughing of parts, suppuration and "ripening" of abscesses and "cleaning off" of wounds, are facilitated by moderate heat, but hindered by cold.

Disinfectants, Antiseptics and Deodorants.

Disinfectants, or *germicides,* are agents which destroy the micro-organisms, causing infectious and contagious diseases, fermentation and putrefaction. *Antiseptics* are agents which prevent or retard the growth and development of the micro-organisms occasioning fermentation, putrefaction and disease, more especially the micrococci producing suppuration.

Deodorizers, or *deodorants,* are agents which destroy or counteract a foul odor. They are not necessarily antiseptics or disinfectants. Considerable confusion exists in relation to the terms disinfectant and antiseptic, because the latter is often described as an agent which inhibits the growth, or destroys the life of the micro-organisms of fermentation, putrefaction, and disease. This definition makes antiseptics synonymous with disinfectants. The distinction exists, however, according to common usage, that while disinfectants may, in dilution, act as antiseptics, antiseptics are not often disinfectants, and in the nature of things are not strong enough to kill germs, although they may hinder their growth. Antiseptics may then be regarded as a subdivision of disinfectants. The two terms are unnecessary and misleading, as either might embrace both interference with the growth and destruction of micro-organisms. Disinfection may fall short of sterilization; *i.e.,* death of all germs. Repeated boiling of a fluid containing micro-organisms wholly kills them; but, while disinfectants may destroy the germs of disease, they often fail to kill more resistant and harmless organisms, as the spores of B. subtilis.

A discrimination between disinfectants and antiseptics may be made in relation to their connection with the body. Those agents employed to kill germs, in matter distinct from the living body, are disinfectants; while those agents applied on the surface, or introduced within the body, may be classed as antiseptics, since they can rarely be used in such strength as to kill all micro-organisms without injuring or killing their host.

DISINFECTANTS AND DISINFECTION.

Air, sunlight, heat and water are naturally the best disinfectants. Air scatters and dilutes micro-organisms, making them pathologically inactive. There is no more effective way to disinfect a stable, in which animals are living, than by free ventilation with pure air. It is well known that animals are less liable to contract infectious diseases in the comparatively pure air of the country than in closely crowded and ill-ventilated city buildings. Likewise, the contagious

diseases of children mostly occur in winter, when they are herded together in schools and in poorly ventilated dwellings.

To attempt to disinfect the air surrounding a patient is the height of absurdity. The generation of chlorine and sulphurous acid gases for this purpose, although recommended in text books, is futile, and by irritating the respiratory mucous membrane, accomplishes more harm than good, since a congested surface offers a more suitable field for bacterial growth. Air, on the other hand, may be a medium of infection when contaminated with dust containing pathogenic bacteria (B. tuberculosis). Sunlight is prejudicial to the vitality of bacteria. Whereas the bacilli of tuberculosis will live almost indefinitely in dark, damp places, they quickly succumb to sunlight and dry air. Sunlight and pure air are, then, imperative for both the immediate and preventive treatment of germ diseases. Heat is the most powerful agency for disinfection at our command. Dry heat, to be efficacious, must be applied at a temperature of 140° C. (284° F.) for three hours to kill all bacteria and spores; but this degree of heat scorches most fabrics and destroys many materials. Boiling water quickly kills all non-spore-bearing pathogenic bacteria, and these include most of the organisms causing the common contagious and infectious diseases (anthrax excepted). Two hours of continuous boiling will not destroy the most resistant micro-organisms—the spores of the hay bacillus—but moist or saturated steam, at 230° F., will infallibly kill any spores whatsoever within a few minutes. Fire is the most complete disinfectant, because it not only destroys germs, but their food and products. Water, like air, dilutes germs and aids oxidation and destruction of organic matter; but, again like air, drinking water may be the source of infection when sufficiently contaminated.

MECHANICAL MEANS OF PROCURING ASEPSIS.

Hitherto the placing of sole reliance on chemical agents to secure surgical sterility of the skin and fresh infected wounds has been a mistake. It has been impossible to render living, infected tissue sterile by merely bathing it in chemical solutions. In other words asepsis has been procured most satisfactorily by mechanical means and the chemical has played a secondary part.

Thus the most efficient method has been to remove the hair from the skin surrounding a wound or operative area, and to shield the wound with sterile gauze meanwhile. Then the skin was actively scrubbed for 10 minutes with green soap and water and followed with 70 per cent. alcohol. The wound was then exposed, foreign matter and loose tissue removed by forceps and scissors, and the

wound scrubbed, syringed or douched for 10 minutes with normal salt lysol, or other solution. Now we have learned we can sterilize the skin and infected raw tissue without the scrubbing, and washing, and other laborious methods and with apparently as good results by using iodine (See p. 650).

CHEMICAL AGENTS.

Mercuric bichloride, carbolic acid, quicklime, chlorinated lime, sulphurous acid, and chlorine, are more frequently employed as disinfectants. Corrosive sublimate solutions are decomposed by keeping, and by contact with albumin and ammonia. Acids, or common salt, added to bichloride solutions prevent, in a measure, this decomposition; but, nevertheless, mercuric bichloride is rendered unfit for the disinfection of masses of decomposing albuminous matter, as manure. One of the best solutions, employed by the Paris Disinfection Service, is composed of corrosive sublimate 2 grammes; tartaric acid, 4 grammes; and water, 1 litre (1-500), colored with 5 drops of a 5 per cent. solution of indigo carminate. An English solution, in common use, consists of corrosive sublimate, 1 ounce; hydrochloric acid, 2 ounces, and water to make 3 gallons (1-768). The usual strength of corrosive sublimate solutions, for disinfection, varies from 1-500 to 1-1000. These solutions are suitable for articles made wholly, or in part, of leather, rubber and fur; for blankets, cotton and woolen fabrics, and for floors, walls, and wood work of stables. Surgical instruments, and other metallic implements and fixtures, are injured by corrosive sublimate solutions. Carbolic acid is more expensive than corrosive sublimate, and less efficient in cases where the latter is applicable. Carbolic acid can, however, be used to disinfect albuminous material and metallic substances. It is employed on animal excreta in 5 per cent. aqueous solution (about 8 ounces to the gallon of hot water). This solution will cause the hands to dry, crack and fissure if they are immersed in it for any length of time. A two per cent. solution of commercial cresol is as efficient and cheaper than a five per cent. carbolic acid solution; or a four per cent. solution of the U. S. P. Compound Solution of Cresol may be used.

Chlorinated lime and quicklime are good disinfectant agents to mix with animal evacuations. In fact, bleaching powder is probably the best and cheapest disinfectant we possess for use in privies, drains, sinks, cesspools, and sewers, and for the destruction of microorganisms on floors, and in fæces and urine.

A few pounds of this preparation may be thrown into privies or cesspools once a week, and the pure compound, or a saturated

solution, may be scattered over floors or mixed with manure. A 5 per cent. solution is used to disinfect harness, which should be washed and greased directly afterwards. Stagnant and putrid water may be rendered safe and drinkable, after some hours, by the addition of ½ to 1 ounce to each 65 gallons of water. Chlorinated lime is a powerful deodorant as well as disinfectant, but is of no value in either capacity unless the compound contains so much chlorine gas that the face cannot be held near it without the production of great irritation to the eyes. It is used in 5 to 10 per cent. solution in water (or in whitewash) for disinfection of premises and on excreta. Bleaching powder should be placed upon decomposing animal bodies, and sheets wet with a saturated solution should be wrapped about the carcasses of animals dead from contagious diseases, to prevent infection during transportation. Disinfection by sulphurous acid and chlorine gas is done to destroy germs which cannot be reached by other methods. Three pounds of sulphur and two ounces of turpentine or alcohol (to afford moisture and aid combustion) are needful for every 1000 cubic feet of air space. Sulphur is generally burned in an iron vessel placed on sand, or floating in a tub of water. If the building is sufficiently tight to insure proper disinfection, it is difficult to secure combustion of the proper amount of sulphur. To obviate this, the sulphur may be saturated with turpentine, ignited and placed in an iron kettle on a tripod over an alcohol lamp. Chlorine is disengaged from chlorinated lime, to which is added crude muriatic acid, one pound of former to three of latter for every 5,000 cubic feet of air space. Buildings must be tightly sealed and made completely irrespirable for animals during the space of three hours. Sulphurous acid disinfection will not kill the spores of anthrax and should never be allowed to replace thorough mechanical cleansing and disinfection with other chemical agents, but may be utilized, as an additional safeguard. Chlorine gas is more reliable. Formaldehyde is now being employed by most boards of health for general disinfectant purposes, and it appears to be the best means of gaseous disinfection. (See p. 310.) In most barns gaseous disinfection is useless because the premises cannot be made air-tight.

ANTISEPTICS.

It is perhaps well to consider here the sources of infection and the natural defenses or immunity possessed by animals against parasitic invasion. Pathogenic micro-organisms are commonly brought in contact with the body through the agency of the air, drinking water and food, and insects (flies, ticks and mosquitoes). and gain entrance by means of the air passages, digestive canal and blood; but even in

the two former cases, the micro-organisms are in a certain sense outside of the body, since it is not easy for them to penetrate the intact and healthy ciliated mucous membrane of the respiratory tract. But when the mucous membrane is damaged by inflammation, and the ciliæ become paralyzed, and abnormal secretions are formed, then a favorable opportunity is offered for their growth and entrance into the circulation. In the digestive tract the hydrochloric acid of the gastric juice and bile* act as natural antiseptics, while the liver is thought to destroy toxins resulting from bacterial life.

When digestion is in a normal condition, putrefaction and fermentation do not occur; but when its activity is diminished, and the secretion of the digestive juices is lessened, and the hepatic functions are depressed, then a chance is offered for bacterial growth, fermentation and absorption of toxins, or even actual transmigration of micro-organisms through the intestinal walls. To these natural agencies of defense, which may be likened to outlying pickets shielding the animal from bacterial invasion, we must add the intrinsic power of resistance vested in the tissues, blood serum (opsinins, bacteriolysins, agglutinins), and leucocytes in combating micro-organisms; and the production of antibodies in the system antagonizing the toxins formed by bacterial action. Micro-organisms are always to be found on the surface of the body and within its natural cavities open to the air, but pathogenic bacteria are less likely to do harm if the animal is in a healthy condition. A limited number of bacteria (micrococci) may even exist within the blood in health, and this fact accounts for suppuration occurring when the tissues are severely injured, without solution of continuity. The internal use of antiseptics is of comparatively little value, even when these agents come in direct contact with germs in the digestive tract. This follows because it is impossible to administer antiseptics in sufficient amount to seriously interfere with bacterial growth in the tissues, without injuring or even killing the patient.

There are certainly known but two instances (quinine in malaria and salversan in syphilis) where the exhibition of an antiseptic will inhibit the development of micro-organisms of a general infectious disease, and so absolutely arrest it. It is probable, however, that salicylates in rheumatism, and carbolic acid in tetanus, act therapeutically as internal antiseptics. Antiseptics are of benefit in rendering the contents of the digestive tube more or less aseptic, and (after absorption) they exert some antiseptic action on the mucous membrane of the respiratory tract (volatile oils), and also on the urinary tract (urotropin), during their elimination. The principal

* Experiments in human patients show that many forms of pathogenic bacteria may live in bile. It is but moderately bactericidal.

agents used as antiseptics for surgical purposes are: iodine, carbolic acid, creolin, lysol, hydrogen dioxide, corrosive sublimate, potassium permanganate, zinc chloride, iodoform, salicylic acid, aristol, iodol, and boric acid. Those employed internally include naphthol, salol, creolin, carbolic acid, bismuth salicylate and subnitrate, quinine, salicylic acid, and many others. For a more detailed description the reader is referred to special articles on these agents in the preceding pages.

DEODORIZERS OR DEODORANTS.

Deodorants are not of any practical value in simply exchanging one odor for another, but, as in the case of chlorine, they sometimes actually destroy compounds which give rise to the stench. Sewer and other malodorous gases, resulting from foul decomposing matter and excreta, may be freer from bacteria than ordinary air, and are not usually the carriers of micro-organisms, nor the cause of specific infectious diseases. These gases do, however, occasion indefinite symptoms of ill-health. Deodorizers, which are also disinfectants, are of service in destroying noxious emanations and their source; but, to accomplish this, it is necessary that they come into direct contact with putrefying material, and should not be placed about the habitations of man or animals, with the ridiculous idea that they are achieving more than the production of a vile odor.

PRACTICAL DISINFECTION.

The premises occupied by animals suffering from contagious diseases, together with all articles contained therein, such as harness, blankets, stable implements, and evacuations, must be disinfected after the removal of all animals and isolation of the sick First, all parts of the premises must be cleaned. The woodwork of the floors, ceilings, walls must be swept, and filth removed by scraping if necessary. Floors that are too old to readily clean should be taken up and burned. Manure and valueless infected objects should be burned or the manure mixed with five per cent. solution of chlorinated lime. Where the floors are of earth, the earth should be removed for a depth of four inches and mixed with the chlorinated lime (5 per cent.) solution.

Blankets and clothing should be boiled or soaked for 12 hours in a solution (1 to 500) of corrosive sublimate. Harness should be washed with soap and water and then with 4 per cent. liq. cresolis comp.

The best way to apply the disinfectant is by means of a hand

force or spray pump to every part of the building. In some cases, where only a stall or small area requires disinfection, a brush will do. The best outfit consists of a strong spray pump with 20 feet of hose and 5 feet of straight iron pipe connected to the same, to the end of which is attached a spray nozzle. The disinfectants which are most suitable are 4 per cent. solution of compound cresol solution, or 2 per cent. solution of cresol. This is known as liquid carbolic acid in the market and should contain 90 to 98 per cent. of cresylic acid to be efficient. Either of these disinfectants may be used alone or, in the strengths mentioned, in whitewash. Thus one slakes 7½ lbs. of lime with hot water and mixes it to a creamy consistency. Then to this one stirs in either 15 ounces of cresol, or 30 ounces of compound cresol solution, and adds water to make 5 gallons.* A specially liberal application of the disinfectant must be made to feed boxes, gutters and drains. If one uses the disinfectant alone it is well, after it is dry, to apply a coat of whitewash to the premises. A 1 to 500 corrosive sublimate solution may be used in place of the agents recommended when the avoidance of odor is necessary as in the production of milk. This should be followed by a coat of whitewash. Gaseous disinfection is now in order where the stable can be made air-tight and the animals removed. Formaldehyde (p. 310) or sulphur (p. 238) may be employed. Live steam is the most useful when a suitable apparatus for its applications to woodworks, haymows, etc., is obtainable. After thorough ventilation healthy animals which have not been exposed to infection may be allowed to return to the disinfected quarters.

SURGICAL ANTISEPSIS AND ASEPSIS.

It may be fitting, and not out of place, to briefly outline here the use of antiseptics and asepsis in veterinary surgery. Since the days when Lister introduced antisepsis, surgery has advanced in a manner which appears, however, like retrogression. It is now conceded that asepsis can be attained more satisfactorily and safely without the general use of antiseptics. For antiseptics, as has been noted, inflict a certain amount of damage upon denuded surfaces, and, in so far, lessen the resistance of the body to the inroads of bacteria. Modern surgery attempts to secure a comparative asepsis by mechanical cleanliness, which is more efficient, simpler, and harmless to the body. Antiseptics are indicated to assist asepsis in the toilet of the unbroken skin, and when sepsis has already occurred, or is unavoidable. The gross neglect of aseptic precautions, often seen

* Farmers Bull., No. 480 U. S. Dept. Agric., 1912.

in the operations of veterinary surgery, would be considered criminal practice in human surgery.

Asepsis is, nevertheless, very difficult to secure in the lower animals living among filthy surroundings and lying on fecal discharges. In addition to these disadvantages the trouble of controlling animal movements during operation, and of keeping dressings in place, make the attainment of asepsis embarrassing and frequently impossible. The more common administration of anesthetics would facilitate asepsis by preventing movements of the patient and contact of the operative field with dirt.

But there are all degrees of infection, and while, with the best methods of securing cleanliness at our command, it is impossible to completely sterilize normal skin and tissues, yet the surgical result may be perfect. Therefore, in surgical operations, we should endeavor to procure as small an amount of infection, or dosage of microorganisms, as possible, consistent with existing environment and conditions.

The following aseptic technique is especially applicable in the case of any surgical operation undertaken upon a noninfected part. If it is possible to carry out all the details, and the result is successful, healing will take place without suppuration.

To prepare the surface of the body for operations, the hair is first clipped and shaved, the skin is thoroughly scrubbed with a brush, green soap and water for ten minutes, and then with 70 per cent. alcohol. Since tincture of iodine has come into vogue the preceding method has been superseded by iodine with many operators. In this case the hair should be shaved the day before when water and soap may be used. Before the operation the dry skin is cleansed with gasoline, or when this is undesirable on account of its inflammability, ether may be used. Then tincture of iodine is painted all over the operative field and allowed to dry before the operation is begun. On delicate parts the tincture should be diluted with an equal amount of alcohol. After the skin is incised there is no further necessity for antiseptics unless the wound is already infected, or becomes so by exposure to impure air or contact with dirt. The hands of the operator, including the finger nails, should be brushed until clean with green soap and water, and then with 70 per cent. alcohol.

In accidental wounds the tincture of iodine is the most efficient agent.

As we have seen the skin must not be wetted with water in order that the iodine penetrate into its "pores." Washing also carries germs into the wound. The hair should be cut from the dry skin with scissors or by shaving the dry skin with a razor. The

skin is cleansed by mopping with gasoline or ether and the dirt removed from the wound by forceps and scissors and gauze.

Then a large surrounding area of skin and the wound itself should be swabbed with pure tincture of iodine by means of a brush, or absorbent cotton on a stick. After suturing the wound it is best to swab over the line of sutures with tincture of iodine and allow it to dry before dressing. In burns and all accidental wounds and emergency cases the iodine treatment is *the* thing. On delicate skin and mucous membranes the dilution of the official tincture with an equal amount of alcohol is indicated.

It is well for all participating in an operation to wear thin rubber surgical gloves after thorough hand-disinfection—in pus cases, to prevent contamination of the hands; in clean cases, to avoid infection of the wound from the hands. If gloves are not worn in operating upon clean cases, they are all the more useful in dressing or operating upon pus cases to avoid contamination of the hands which later might give rise to wound infection when the naked hands come in contact with a clean wound. Instruments are thoroughly scrubbed with soap and water, and boiled for ten minutes in an aqueous solution of sodium bicarbonate (1 teaspoonful to the quart), and then placed in a solution of carbolic acid (1-40), or removed to a sterile towel. New sponges only should be employed, which have been previously cleansed, and then soaked in carbolic acid (1-40) solution, or pieces of sterile gauze may be used.

If irrigation is desirable, normal salt solution (1 heaping teaspoonful to the quart of sterile water) is appropriate. Nothing else but this is allowable within the non-infected abdominal cavity.* Sutures of silk, and needles, are prepared by boiling in water for thirty minutes. The area about the operative field is to be surrounded with cloths, or towels, which have been boiled or baked, and instruments and sponges may be laid on these.

Dressings may consist of gauze † which has been exposed for three hours to dry heat at 140° C. (284° F.), or placed in an oven of an ordinary cooking stove, in closed tin cans, until it becomes scorched and slightly brown. The same gauze may be used for sponges. Unsterilized articles are not to be suffered to come in contact with the operator, or wound, during the operation.

Wound infection from exposure to the air and other media, is prevented by immediate dressing and bandaging, or by collodion applications.

† Sterilized gauze is now sold by all druggists.

Venesection.

Venesection, or blood-letting, formerly abused, has, for that reason, fallen into almost complete disuse. This is unfortunate, since blood-letting is a valuable and often life-saving measure. The indications for venesection are chiefly limited to conditions associated with a general high arterial pressure and local engorgement of some organ.

In such cases venesection very rapidly reduces general blood-tension to a point lower than that existing in the engorged region, so that congestion is relieved. A full, incompressible pulse is said to indicate the desirability of venesection in severe acute disorders—in accordance with the above—but this is not by any means invariably the fact, as will be shown.

Venesection leads to a reduction of temperature, and vascular tension is lowered for from 3 to 48 hours, according to the quantity of blood withdrawn, but the blood vessels quickly adjust themselves to the smaller mass of blood, and the original quantity of this vital fluid is soon restored (24 to 48 hours) through absorption from the tissues and alimentary canal. The heart beats more rapidly, owing to the lessened resistance in the vessels, and venesection is accompanied by nausea and prostration.

The blood is less dense and more fluid after blood-letting, and for this reason, if inflammatory processes follow, exudation is more apt to ensue. The fibrin is first regained, then the normal number of white, and finally that of red corpuscles, in from one to five weeks. Circulatory depressants—as veratrum viride—accomplish much the same results as blood-letting, by causing general reduction of vascular tension and relief from local congestion, thus "bleeding an animal into its own veins" without loss of blood, it is true, but with less rapid and certain effect.

Cathartics, diuretics and diaphoretics also lower blood pressure by abstraction of fluid from the vessels, but their action is slow. The following disorders are those most suitable for treatment by venesection when they exist in an alarming form in robust animals:

Cerebral congestion. In insolation and tympanites.
Apoplexy, particularly parturient apoplexy of cows.
Encephalitis.
Acute cerebral meningitis.
Active pulmonary congestion and apoplexy
Passive pulmonary congestion in cardiac disease.
Sthenic pneumonia.
Sthenic pleuritis.
Urticaria.
Lymphangitis.
Hemoglobinuria.

Toxemia	Toxemia
" bacterial,	" vegetable,
" mineral,	(Followed by saline infusion.)

Venesection from the jugular in cerebral congestion is, in fact, a species of local blood-letting by directly draining blood away from the brain; and it preserves life by preventing pressure on, and paralysis of, the great vital medullary centres controlling the respiration and heart. Moderate blood-letting is sometimes advisable in the early stages of severe inflammatory attacks of the brain or its membranes.

In cerebral congestion, and dyspnea due to gastric tympany and pressure on the diaphragm, bleeding may give relief. Blood-letting was formerly used in the treatment of parturient apoplexy of cows, and, when the disease has once occurred, it may be employed as a prophylactic measure in plethoric animals immediately before parturition. Venesection alleviates dangerous pulmonary congestion, removes the venous load on the right heart, and relieves dyspnea and cyanosis by making it possible for the heart to force a smaller quantity of blood through the less obstructed lungs.

A feeble and easily compressible pulse does not necessarily contraindicate venesection in engorgement of the lungs, for this condition leads to stasis in the pulmonary circulation, prevents the proper flow of blood into the left ventricle, and thus causes arterial anemia. Therefore, so far from contraindicating blood-letting, this condition urgently demands it. Alarming dyspnea, great cyanosis, together with a general plethoric state, should guide us in blood-letting in sthenic pneumonia and pulmonary congestion, rather than the state of the pulse. Venesection is serviceable in advanced cases of cardiac disease in dogs—with failing compensation, venous engorgement of the lungs, and dyspnea—by relieving the obstruction to the right heart. Moderate blood-letting is occasionally useful in severe cases of acute pleuritis, laminitis, lymphangitis and urticaria in plethoric horses.

Finally, in various toxemias, blood-letting drains away both the blood and its contained poison. The mass of blood removed may be advantageously replaced by injection of normal salt solution into a vein or under the skin. This method is not in prevalent use in veterinary medicine, but is applied with notable success in human practice. Every veterinary practitioner should be competent to bleed an animal. An amount greater than ⅕ of the total quantity of blood should not be withdrawn. The total quantity of blood is equal to about 13.5 per cent. of the body weight in horses; to 2.2 per cent. of the body weight of fat swine; to 6.6 per cent. of the body weight in dogs, and to 7.7 per cent. of the body weight in man. Large

horses or cattle may be bled to the extent of from 4 to 6 qts.; smaller subjects, 2 to 4 qts.; sheep, ½ to 1 pt.; dogs, 4 oz. to 1 pt.

Blood-letting is generally done to animals in the upright position by shaving the hair and sterilizing the skin over the jugular vein in the upper part of the neck. The vein is made prominent by pressure below the site of operation, and a fleam, or knife carefully guarded, is plunged transversely into the vein, making a good clean incision. The blood should be quickly withdrawn and carefully measured and the effect on the pulse noted, and the blood-letting maintained until there is noticeable reduction in the vascular tension and other symptoms, for the relief of which venesection is employed. The bleeding is arrested by suturing the lips of the wound and by pressure with a bandage.

Local Blood-letting, or Scarification, is often useful in relieving tension and pain in locally congested or inflamed tissues, and may even avert death of the part. Furthermore, stasis is removed and exudation from the engorged vessels may be prevented, while a fresh supply of arterial blood flows in to reinstate the vital processes.

Scarification is practiced by making numerous small, parallel incisions into the skin, fascia or other tissues in the long axis of a limb or part. In inflammation of the periosteum it is necessary to puncture this membrane. Bleeding is facilitated by warm poulticing, and is arrested by packing the incisions with sterile gauze.

INDICATIONS.

Lampas.	Mastitis.
Glossitis.	Laminitis.
Periostitis.	(To secure blood for microscopic examination.)
Cellulitis.	
Conjunctivitis.	

Sometimes the veins leading from an inflamed area are opened, thus securing local abstraction of blood, *e.g.,* the digital veins in laminitis; the milk veins in mammitis.

Scarification, or puncture, is indicated in the above-mentioned conditions whenever there is great swelling, pain and tension in the affected parts, and not otherwise.

Transfusion.

Transfusion is the transfer, directly or indirectly, of blood from one living animal to another. In this process the blood must be obtained from an animal of the same species as the patient. Transfusion has been discarded in the past because of the dangers of sepsis,

embolism, destruction of the infused blood corpuscles and nephritis. Within the last few years direct transfusion has been widely done, and with very little danger, in human surgery.

Crile in this country has been the chief means of making the method popular and practicable. He has devised a special tube for performing anastomosis so that the intima of the artery of the donor will come into contact with that of the vein of the recipient. The author has many times done transfusion in dogs with this tube, using the femoral vein of the recipient and an artery of the donor. Now there are many substitutes for Criles' tubes, one of the simplest being glass tubes coated with paraffine, or sterile, liquid vaseline, which are perfectly satisfactory.

Direct union by suture of artery of the donor with vein of the recipient is now commonly practised. The technique belongs to the domain of surgery.

Transfusion is particularly indicated to supply loss of blood in the recipient following severe hemorrhages.

In some diseases of the blood and in poisoning by gas it has also proved of life saving value.

The injection of warm, normal salt solution (.6 of 1 per cent.) has been found to fill many of the indications for transfusion of blood, and yet is free from the dangers and difficulties besetting the latter.

Saline Infusion.

Saline infusions are intended to replace the normal blood plasma, and, therefore, should contain approximately the amount of sodium chloride—.6 of 1 per cent.—contained in this fluid. The solutions should be filtered and boiled previous to their use, when this is possible, and are made by adding a heaping teaspoonful of sodium chloride to the quart of sterile water, which is used at a temperature of usually 103° to 115° F., according to the mode of introduction and circumstances.*

Simple distilled and ordinary water are noxious to the tissues,

* The true proportion of sodium chloride in blood plasma of mammals is .8 per cent., or 123 grains to the quart. 0.6 of 1 per cent. of sodium chloride is not really "normal" for mammals, but was deduced from that found in the plasma of frogs. The injection of a too dilute saline solution will cause the red blood cells to swell and part with their hemoglobin and will lead to great sweating and diuresis in the effort of nature to restore the plasma to its proper composition. A more exact solution for saline infusion consists of: Sodium chloride, .8 per cent.; potassium chloride, .03 per cent.; calcium chloride, .02 per cent.; water, 100. In emergencies, ordinary table salt (which contains a slight amount of calcium chloride, causing its deliquescence), in the proportion of 123 grains to the quart or a level teaspoonful to pint of sterile water, may be employed for intravenous infusion or hypodermoclysis.

while salt solution is entirely innocuous unless it contains three times the quantity of sodium chloride normally present in the blood.

Mode of Introduction.—Saline infusions are introduced within the body (1) by intravenous injection; (2) by injection into muscular tissue (hypodermoclysis); and (3) by rectal injection (enteroclysis).

Intravenous injection is the most rapid and certain method, but not so simple and practicable as hypodermoclysis.

Any superficial vein which can be readily seen and isolated, may be utilized; preferably the jugular or internal saphena vein in animals; the median basilic, or cephalic, at the bend of the elbow in man.

The apparatus consists of a glass funnel or rubber bag connected by four or more feet of rubber tubing, with a canula or curved piece of glass tubing 4 inches long and ¼ inch in diameter for horses; ⅛ inch in diameter for dogs. The apparatus should be boiled immediately before using. The vein is made prominent by manual pressure exerted by an assistant, or by a bandage, applied proximally to the seat of operation. The hair is shaved from the part, which is sterilized, and an incision 1½ to 2½ inches long is made by lifting a transverse fold of the skin directly over the vein and snipping off the top of the fold with scissors parallel to its long axis. The sheath of the vein is exposed, raised by dissecting forceps, and divided. The vein is then lifted from its bed with an aneurism needle, and two silk or catgut ligatures are drawn under it about an inch apart. The vein is now incised longitudinally, and, as the blood begins to spurt out, the distal ligature is tied about the vessel. The canula is next passed into the incision in the vein toward the heart and proximal ligature is tied, with the first part of a surgeon's knot, about the vein and canula, holding the latter in place and preventing leaking of the salt solution from the vessel. When the injection is completed, the tube is withdrawn and the proximal suture is tied on the heart side of the incision, and thus the vessel is occluded on either side of the seat of operation. A simpler method consists in connecting the tubing with a sterile, hollow aspirating needle which is plunged into the vein through the skin or, more certainly, after exposing the vein as above. The apparatus filled with salt solution—including the funnel, tubing, and canula—at a temperature of 103° to 110° F. before its introduction into the vein, and the funnel should be kept full during its use to prevent the entrance of air into the vessel. Any pressure, previously employed between the incision and the heart, should of course be removed before beginning the injection. A little sterile absorbent cotton may be placed at the bottom of the funnel before the salt solution is poured into it, if the solution

has not been previously filtered. In using the apparatus the funnel is raised about two feet above the vein. The quantity of salt solution to be injected will vary from a few ounces to two pints in the case of dogs; from 2 to 6 quarts for horses. Enormous quantities of normal salt solution may be introduced into the blood without harm, even an amount equal to four times that of the blood, providing the inflow is not too rapid; *i.e.,* exceeding one fluid drachm to the pound of live weight in fifteen minutes. When this amount is exceeded the heart and kidneys cannot take care of the great quantity of fluid in the vessels and tissues. A return to the normal volume, force, and rate of the pulse, and of color to the mucous membranes, will lead us to stop the saline infusion. The use of intravenous saline injections is frequently followed by a reaction within half an hour, characterized by a severe rigor, succeeded by sweating, labored breathing, a strong pulse and increased urinary secretion.

Hypodermoclysis.

Injection of warm (103° to 105° F.) normal salt solution into the muscular tissue of the neck, abdomen or flank, is done aseptically with the same apparatus employed for intravenous saline infusions, using a large hollow needle to thrust under the skin instead of the glass tube for intravenous injection; or a fountain syringe filled with saline solution and attached to a sterile aspirating needle may be used; or a reversed aspirator apparatus may be utilized: *i.e.,* by filling the jar with salt solution and forcing the air into the jar, thus displacing the fluid. The fountain syringe is the best apparatus. Hypodermoclysis may be employed in the same cases as intravenous infusion, and is a better method on account of its simplicity. We are guided as to the quantity of solution desirable by the same indications noted above as referring to intravenous saline injections. Hypodermoclysis may be done in several places, and absorption is assisted by massage. Salt solutions are injected under the udder in females, and are occasionally thrown into the peritoneal cavity, particularly after operations in this region, before closing the abdominal walls.

Enteroclysis.

Enteroclysis applies to slow, rectal injection of normal salt solution (105° to 120° F.) to secure absorption. This method may be applied in cases not so urgent as to demand intravenous saline infusion or hypodermoclysis, more especially moderate degrees of hemorrhage, shock, collapse and circulatory depression, when the in-

trinsic heat of the injection is valuable in restoring the normal bodily temperature.

USES.

INDICATIONS FOR SALINE INFUSIONS.

- Grave hemorrhage.
- Shock, traumatic, operative, and electric.
- Suppression of urine.
- Severe diarrhea.
- Eclampsia.
- Purpura hemorrhagica.
- Hemoglobinuria
- Toxemia { Bacterial. / Mineral. / Vegetable.
- In threatened death from any accidental cause.
- In any disease with feeble heart and low vascular tension.

Hypodermoclysis, or the intravenous injection of saline infusions, find their greatest usefulness as life-saving measures in severe hemorrhage. While these methods are not in vogue in veterinary practice,* they have become recognized procedures of great value in human medicine. The indications, following hemorrhage, are to fill up the vessels and to restore vascular tension, since danger is imminent, not from loss of blood corpuscles, but from lack of a circulating medium. There is a sufficient number of red corpuscles to carry on the respiratory and oxygen-bearing functions even after the greatest loss of blood possible from ordinary causes. In fact, respiration is but slightly impaired in human subjects suffering from pernicious anemia, when there is a 90 per cent. reduction in the normal number of red corpuscles, and two-thirds of the blood may be withdrawn from animals and replaced with normal salt solutions without serious damage resulting. In shock there is general vasomotor paralysis, so that most of the blood collects in the abdominal veins, while the ventricles and arteries are emptied. In this condition saline infusions (105° to 110° F.) are of infinite value, because absorption of drugs from the digestive canal and subcutaneous tissue is impaired. Saline infusions greatly dilute the blood—and, therefore, poisons in the blood—in toxemia, while they increase the activity of the kidneys and elimination of toxins. The intrinsic heat of the injections is thought to stimulate antitoxin formation, and the

* Since writing the above, favorable reports of the use of saline infusions have been accumulating. Thus G. W. Dunphy (*Amer. Vet. Review*, June, 1905) writes that he treated two cases of purpura hemorrhagica in the horse by injection of 6 liters of normal salt solution following the removal of 5 liters of blood from the jugular (by means of a trocar and canula), and, at the end of twenty-four hours, bled 2 more liters and injected 3 more liters of salt solution with very happy results. He also demonstrates the wonderful life-saving influence of intravenous saline infusion after the loss (by a horse) of 25 liters of blood.

restoration of vascular tension is believed to assist the natural bodily resistance of the patient.

A great variety of disorders have been treated successfully in human medicine with saline infusions, on this basis, including: septicemia, pneumonia, uremia, diabetic coma, purpura hemorrhagica, tetanus, ulcerative endocarditis, pyelitis; acute alcohol, ether, chloroform, carbonic monoxide, arsenic and mushroom poisoning; and toxemias resulting from acute infectious disorders. The same treatment might be applied to hemoglobinuria and other toxemias peculiar to the domestic animals. Venesection for the purpose of removing the poisoned blood should, in most cases, be resorted to prior to practising saline injection in the toxemias. Excluding shock and hemorrhage, where heat is invaluable, saline infusions are generally given at the temperature of 103° F. by the rectum, under the skin, or into a vein.

Kunsel's Treatment for Milk Fever in Cows.

This special form of treatment merits the attention of the veterinary profession because of the remarkably successful results which have been almost universally secured in the case of milk fever, which is not only a very common disease, but one which has hitherto baffled the best therapeutic attempts of the veterinarian. Following the Schmidt treatment with his intramammary injections of potassium iodide—which was productive of great diminution of the mortality of milk fever, but was often followed by local injury to the udder—M. Kunsel, of Lucerne, in March, 1903, made his first report of the method under discussion. This consists in the following: A tank of compressed oxygen, which can be had of any of the wholesale drug houses, is connected by rubber tubing six feet in length to a milking tube and firmly wired to the nozzle on the tank and to the tube, which should be boiled previous to use. The udder of the cow affected with milk fever should be stripped of milk and thoroughly washed with warm water and soap and the teats cleansed with 70 per cent. alcohol or some other effective antiseptic. The milking tube is then introduced into one of the upper teats and the oxygen gas is allowed to flow slowly into the teat until the corresponding quarter of the udder is tense and well distended. While pinching the teat to prevent the escape of gas, the tube is withdrawn and a strip of bandage or tape is bound about the lower part of the teat to retain the oxygen. The same procedure is repeated in each of the remaining teats. The ligatures on the teats may be permitted to remain in place for an hour and a half, when they should be removed. The inflation of the udder may be repeated in six hours, if necessary,

owing to the non-improvement of the patient. As synergistic measures, the subcutaneous injection of one-half grain of strychnine nitrate, the use of enemata to empty the bowels, and catheterization are important in aiding recovery.

The animal should also be comfortably propped up with bags of hay.

If oxygen can not be readily obtained, the use of a bicycle pump connected with a milking tube may be employed with much success; some veterinarians claiming that the results are as good as with the use of oxygen, providing the air is pure which is pumped into the udder. This purity of the air may be attained by blowing the air through a wash bottle containing 2 per cent. carbolic acid solution.

Very convenient arrangements are now commonly sold at a small price for inflating the cows udder with air. These consist of a rubber bulb and tubing, a chamber containing sterile cotton (through which the air is filtered) and a milking tube for introduction into the teat. They may be used by the laity, and their employment has been as satisfactory as when oxygen was injected. The cow with milk fever should not be milked for ten or twelve hours after inflation of the udder, and only partially milked for several days following this time. Either emptying the udder of air by rubbing, or of milk by milking, within a few hours of inflation, has frequently led to a renewal of the disease in its worst form. The use of the tape to retain the injected air is said to be unnecessary, provided one compresses the teat for a few minutes after inflation. This needs further endorsement before general acceptance.

The results of the Kunsel treatment are wonderful. Kunsel reported a series of twenty-two cases of milk fever, without a death, following the use of his method. Similar results have been secured in this country. The *rationale* of the treatment has yet to be elucidated. Various hypotheses have been advanced, such as the effect of the oxygen on a hypothetical anerobic bacillus in the udder; the action of the oxygen on the blood and general metabolism in destroying toxic products in the economy; the action of air-compression in the udder in overcoming congestion in this part, and thus preventing anemia of the central nervous system; and a possible stimulation of the secretory function of the mammary gland with elimination of toxins. The hypothesis most in vogue is that of a cerebral anemia following rapid emptying of the udder of milk and resulting udder congestion. The fact that injection of milk into the mammary gland has produced a condition simulating milk fever appears to augur a local cause of the disease.

The latest and most rational theory is that of Healy and Kastle who find the first colostrum of cows with parturient paresis to be

extraordinarily toxic when injected into other animals, whereas colostrum from normal cows is inert. They believe the disease to be caused by a toxin elaborated in the udder through faulty metabolism and that inflation cures parturient paresis by preventing the absorption of this toxin.

Lavage.

Lavage is a term applied to washing out the stomach with the stomach tube. This process, while an every-day occurrence in human medicine, has been too long neglected in Veterinary practice. Fortunately, new interest was awakened in this useful procedure by Phillips, of St. Louis, who has perfected a tube and demonstrated the practicability of its use.*

The passage of the tube is chiefly of value in acute indigestion of the horse, with gastric flatulence and distention, where pain and danger of rupture of the organ are averted by permitting escape of gas, and by further washing out the stomach in such conditions and in gastritis and engorgement, toxic, fermenting ingesta are immediately removed and the evil results, as tympanites and local inflammation of the stomach and of the intestines, are prevented. In choking, as by oats, the passage of the tube may afford relief, while in poisoning the washing out of the stomach is the one essential treatment. Gastric indigestion and flatulence are shown by colic, distention in the region of the stomach, difficulty in thoracic breathing and eructations of gas by the mouth, or attempts at retching and vomiting.

To pass the tube, the horse may be backed into a stall. The operator stands to the animal's left and an assistant, holding up the horse's head and the distal end of the tube, to the patient's right.

The tube is placed in warm water and the surface is dusted with powdered slippery elm or smeared with vaseline. The left nostril of the horse is also lubricated in the same way.

The operator pushes the tube gently along the floor of the left nasal fossa with the left hand, while guiding its direction with the right hand.

The first obstruction is likely to be met, when the tube has been entered about a foot, by its contact with the turbinates. The point of the tube should then be held downwards, by the pressure of the right forefinger pushed as far as possible into the nostril, while the outer part of the tube is lifted upward to force the point down into the pharynx. When the tube enters the pharynx attempts at swallowing are likely to occur and these are just what are needed to close the epiglottis over the larynx and to force the tube into the gullet.

* *Amer. Vet. Review*, May, 1904.

If swallowing is not evident it may be brought on by pushing the end of the tube gently backward and forward into the pharynx, and, when an attempt at deglutition occurs, the tube should be thrust forward. If the tube goes into the trachea instead of the esophagus, it will meet with little resistance and expired air may be felt coming from it, while coughing often results. If it is in the gullet, the tube will be held more firmly by its walls and only fetid gas may escape with stomach contents. It should by these means be definitely established then that the tube is in the gullet before introducing it farther.

The tube should be made with white marks on the rubber to show when it may be expected to have reached the gullet and again the stomach.

During the course of passing the tube it must be well lubricated.

When the stomach is reached the gas may have already escaped and fluid contents may be siphoned off by filling the tube with warm water from a funnel or syringe, holding the distal end tightly closed and lowering it to the ground so as to permit of the escape of stomach contents by siphonage. If the contents are largely solid, the stomach must be repeatedly filled with 2 to 4 quarts of warm water and allowed to escape again by lowering the outer end of the tube to the ground. If the flow stops, owing to choking of the tube, it may be started again by injection of water into the tube with a syringe or pump.

The latter must not be used to suck out the contents of the stomach except so far, if necessary, as to start the siphonage. The stomach should thus be repeatedly washed until the water comes away clear. If water is injected with a syringe, care must be taken to avoid forcing air into the stomach.

When passage of the tube becomes impossible through one nostril, the other one may be tried. Phillips reports failure to pass the tube in the horse in only 5 per cent. of trials. The tube is best made of red Para rubber and long enough to reach from the stomach to the ground when in place. Occasionally in impacted stomachs it is impossible to pass the tube through the lower portion of the gullet unless a stilette is used in the tube.

For this purpose a wire bent double has proven satisfactory and is easily carried about. The apparatus consisting of an inner and an outer tube is not so generally serviceable as the single stomach tube.

Lavage of the stomach of dogs is accomplished by fastening the animal to a table on its side by tying the feet and a band about the body to the table. A gag made of wood is placed in the mouth to hold the jaws apart. Through a hole in the gag a tube is passed. The tube should be about 5 ft. long and different sizes are required.

A large human catheter, or small human rectal tube, are commonly suitable. To the catheter or rectal tube a funnel is attached by means of a piece of rubber tube and glass tube. After the stomach tube is passed water is poured into the funnel, to the amount of a pint or so, and the stomach is emptied by lowering the funnel to the floor and allowing the water to syphon off. The tube must of course be filled with water when it is lowered, in order to act as a syphon.

Lavage of the stomach and indeed the whole alimentary canal may also be accomplished in dogs by inverting the animals or hanging them up with head downwards and allowing several gallons of warm water to run into the rectum from a tube with funnel attached and raised some 6 ft. above the patient. Water is allowed to flow until vomiting begins. It is well to introduce the rectal tube slowly for several ft. and to compress the anus about the tube to prevent the water from escaping. This method is valuable after foreign bodies or poisons have been swallowed.

Serum Therapy.*

Antitoxic Serum.—The microscopic organisms which cause infectious diseases—of which the bacteria are the most common—act chiefly through the production of certain complex, poisonous, proteid bodies called toxins, which combine with the cells of the vital organism and destroy their vital functions. Indeed, all the classic symptoms of some of the infectious diseases may be caused by injection of the toxins of the bacteria which cause these diseases; such is the case with tetanus and diphtheria.

Our understanding of the effect of antitoxins is based on Ehrlich's classic theory of immunity. Tissue cells possess supposed prolongations or receptors. These combine with special food-products in the blood for which they have an affinity. As soon as a receptor has become attached to a food-product the cell makes one or many new receptors to replace it. These new receptors when abundant are thrown off and exist unattached in the blood. The toxins of disease are proteids and, in their relations to the receptors, take the place of food-products.

They unite with the receptors of cells and cause their death.

* In the use of serum therapy the strictest aseptic precautions are to be used. The animal is prepared by shaving off the hair from the dry skin and painting the skin with tincture of iodine. The syringe and needle must be boiled for five minutes before using. When many animals are injected at one time, it may be sufficient to wipe off the needle after each injection with 70 per cent. alcohol. The puncture may be covered with collodion to advantage. Glass syringes, with asbestos packing on plunger, are most suitable for boiling, the needle connected by rubber tubing.

Acquired immunity is brought about when so many free receptors are produced in the blood that the toxins of a disease unite with these—rather than with the receptors of the cells—and thus the animal is not overcome. These free receptors in the blood are antitoxins and are produced in abundance in the blood of horses injected with diphtheria or tetanus toxins. The free receptors or antitoxins are specific against the particular toxin with which they combine.

Natural immunity may be due to the fact that the animal has not any cell receptors capable of uniting with the specific toxin of the given disease.

To illustrate the method of artificially manufacturing antitoxins, we will take as an example the production of tetanus antitoxin.

Tetanus Antitoxin.—Tetanus bacilli are grown in bouillon for two or three weeks in an incubator, when the culture is filtered free of bacilli and furnishes tetanus toxins. A horse is injected with one-half a cubic centimeter of toxin and an equal amount of Lugol's solution to lessen its virulence. The injections are repeated in increasing quantities till the seventy-second day, when as much as 150 cc. are injected. The horse is very susceptible and reacts with local inflammation at the site of each injection and generally by the production of antitoxins in its blood. A few days after the last injection the horse's immunity is at its maximum—that is, its blood is highest in antitoxic strength. The horse's blood is then withdrawn under strictest aseptic precautions and the serum is decanted after a day or two. The serum is placed in aseptic bottles holding 10 cc., which are sealed.

They are put in an incubator for several days to prove their sterility; if the serum turns cloudy it is rejected. Most serums will keep a year if preserved with a slight amount of carbolic acid or if treated by repeated sterilization below 100° C. Cloudiness in a serum indicates that it is unfit for use.

The activity of a serum is estimated in two ways. First, the amount of antitoxic serum required to neutralize a given volume of toxin of known strength. Second, the strength is stated in units. Thus in tetanus antitoxin the unit is ten times the least amount of serum necessary to save the life of a 350-gram guinea pig for 96 hours against the official test dose of the standard toxin. The test dose is 100 minimal lethal doses of a precipitated toxin preserved under special conditions at the Hygienic Laboratory of the Public Health and Marine Hospital Service; or, to put it in other ways, one tenth unit of antitoxin neutralizes 100 minimum fatal doses of toxin, or 1 unit neutralizes 1000 lethal doses of toxin for a 350 gm. guinea pig.

The dosage is, then, reckoned in units of antitoxin which is the most accurate method. This mode of standardization is

now a legal requirement in relation to diphtheria and tetanus antitoxin for use in human medicine. The same should apply in veterinary tetanus antitoxin and the dosage should be reckoned in units and not in Cc. which means nothing as showing the strength of the serum.

The better makers now standardize their antitoxin according to the human standard. Thus 1 Cc. of veterinary tetanus antitoxin (Mulford) equals 50 American units as defined above.

While the human prophylactic dose is 1500 units that for the horse is only 500 units (10 Cc. Mulford) because one uses a homologous serum, or serum from the horse for the horse. Horse serum is not so potent for man.

The toxin of tetanus is developed by the bacteria of this disease, which gain entrance through wounds of the tissues of the body. The bacilli of tetanus are not distributed by the blood, but remain at the site of infection, and the toxins they produce are taken up by the peripheral nerve endings in the vicinity and carried along the axis cylinders of the motor nerves to the central nervous system. The same thing happens in rabies. When the toxins reach the spinal cord the symptoms of tetanus appear and finally death occurs, when the important centers of the medulla become intoxicated. But the major part of the toxins are absorbed by the lymphatics of the infected area and so pass into the general blood stream where they are neutralized or absorbed by the motor nerves all over the body. Tetanus germs live normally in the intestines of horses, cattle and dogs but neither they or their toxins are absorbed unless the mucous membranes are wounded. Manure, and dust containing it, is therefore especially dangerous. Tetanus bacilli live in the soil, and wounds which are contaminated with dirt or foreign bodies, and those which do not have free access to air—as bruised or punctured wounds—are chiefly liable to the development of tetanus. Tetanus is common for this reason in mules employed in coal mines. It will thus be seen that tetanus does not become apparent until some time after the involvement of the nervous system, and for this reason the use of tetanus antitoxin is not so actively preventive at this period when the toxins have combined with the receptors of the nervous system and are therefore unable to combine with and be neutralized by the antitoxin. Nevertheless, tetanus antitoxin is of some value as a curative remedy in tetanus if used within thirty hours of the beginning of the attack. Tetanus is fatal in proportion to the shortness of its incubation. When antitoxin is given to cases having a short incubation (5-8 days) there is little hope of its success. Bacilli's treatment is preferable (p. 302). When the period of development has been longer (1 to 2 weeks) the chance of recovery is much better with than without antitoxin.

As a preventive agent when employed before infection, or immediately after it, tetanus antitoxin is almost certain. Nocard injected 2,727 horses with tetanus antitoxin in a certain district, and while none of these developed tetanus, there were 259 cases in the same region in unprotected horses. Pecus reports 500 cases of horses with nail pricks of the feet in which not a single case of tetanus developed after one immunizing dose of tetanus antitoxin. The immunity produced by tetanus antitoxin is thought to last from fifteen to thirty days. So-called idiopathic tetanus is in reality traumatic, resulting from small unseen wounds of the mucous membranes or integument. Tetanus antitoxin is then indicated for use in the horse when the case is not acute, or as a preventive where tetanus is prevalent or following wounds the character of which (see above) suggests the possibility of the development of the disease. In such localities it is wise to immunize animals against tetanus with a dose of antitoxin before undertaking surgery (as castration) upon them. The remedy may be employed without fear of doing any damage if properly administered.

There are three ways of giving tetanus antitoxin: as a preventive it may be given under the skin, unless there are reasons to require rapid action, when it should be given intravenously; as a cure, after symptoms have developed, it should be given intravenously or intraspinally. The latter method has proved rather more successful in human practice but large doses of antitoxin given intravenously yield almost as good curative results. It has been found that 3 days are required, after a subcutaneous injection of antitoxin, to produce the same antitoxic result which will occur within one hour after the intravenous injection of the same dose.

If the antitoxic serum is from the same species as the patient (homologous) it is eliminated as slowly as if it had been produced naturally in the body, so there appears to be no reason to repeat the dose of tetanus antitoxin in the horse, if the first intravenous injection is sufficiently large.

As a prophylactic, a dose of 10 cc. or 500 units should be injected subcutaneously in horses and repeated at the end of the first and third week, and later, if there is danger from wound infection. As a curative agent antitoxin is useless in rapidly developing cases but in chronic and slowly developed cases it may be employed.

For treatment of the horse 20,000 units of tetanus antitoxin should be given intravenously at the earliest possible instant. There does not appear to be any reason for repeating the dose until the end of 5 days, when a second dose of 10,000 units may be given if toxin is being produced from a sloughing wound. Formerly daily doses of tetanus antitoxin were advised and, while these do no harm, the expense is great and experiments by Ransom show that the antitoxic

strength of the serum persists a long time if it is homologous. The local treatment of the wound is as important as general treatment. The free opening of punctures to the air, removal of foreign bodies, and thorough washing with antiseptics and drainage are essential, as well as the use of nervous sedatives to control spasms.

An influenza antitoxin is now prepared by some makers of biological products (Parke, Davis & Co.). This is of chief value in affording passive immunity to the disease in horses which are to be exposed to diseased animals or infected premises, as in shipping young horses. A single dose of 30 cc. injected subcutaneously will protect a horse, if given 10 days before exposure.

As a curative agent this antitoxin is of most service in the very beginning of the disease in the same dose (30 cc.) and repeated every 12 hours for 2 or 3 doses. After the disease is well advanced the curative power of the antitoxin is correspondingly less but it may be given in large doses (90 cc.). If given early it shortens the attack and lessens the mortality. It is not possible at present to estimate its precise value. Human diphtheria antitoxin is used with success for the same purpose.

Anti-Strangles Antitoxin.—An Anti-Strangles Serum is now on the market. That made by the Pasteur Laboratories of America is obtained from horses which are given the strangles streptococcus (S. equi) in gradually increasing doses for a year. The serum from these immunized horses is an efficient prophylactic agent and of some value in the early stages of the disease as a curative remedy. All young horses liable to be exposed to the disease from recently bought animals, or by coming in contact with diseased ones in the barn, pasture, road, or in shipping should receive prophylactic doses. Also in receiving horses, recently shipped, it is wise to use the antitoxin, unless it has already been employed. The immunity conferred is thought to last 2 months. The minimum preventive dose is 30 cc.

Anti-infectious Serum.—Antistreptococcus serum is included under this head because it appears to be especially antagonistic to streptococci themselves and to possess antitoxic power. In the preparation of this serum (after Marmorek) streptococci are grown in serum or serous exudate mixed with two parts of peptonized bouillon, and their virulence is greatly increased by repeatedly injecting them from rabbit to rabbit. This virulence becomes in this process so great that an amount of culture equivalent to one single streptococcus will certainly kill a rabbit. Small doses of a culture of living virulent streptococci from the rabbit are injected into the horse from time to time, this animal reacting vigorously to the injections. It is not until the horse has undergone this treatment for a year and has recovered from each injection that a serum is obtained of a sufficient strength to combat living streptococci and their toxins. The blood

of the horse being withdrawn furnishes anti-streptococcic serum. It is now thought by many authorities that the serum to be most effective should be polyvalent—that is, should be active against the many varieties of streptococci by the cultivation of large numbers of streptococci to represent their different toxins.

Marmorek holds, however, that the streptococci causing erysipelas, cellulitis, abscess, sore throat, parturient infections, scarlet fever, etc., are identical; that all produce the same toxins, and that all are antagonized by an anti-infectious or antitoxic serum made from any one or all of them.

The therapeutic results of antistreptococcic serum are not so certain as those following the use of some other serums—notably anti-diphtheritic serum in man—because so-called streptococcic infection is often a mixed infection, by which is meant that produced in part by other bacteria, and because serums produced by the cultivation and inoculation of apparently the same varieties of streptococci seem to differ considerably in their protective value. As in the case of other serums, the therapeutic result is much more favorable when antistreptococcic serum is used as a prophylactic or in the early stages of the infection.

The injection of antistreptococcic serum is practically devoid of danger.

With the qualifications above noted, antistreptococcic serum has proven serviceable in the following morbid conditions: Strangles, medical and surgical septicemia, pyemia, parturient infections, purpura hemorrhagica, influenza, traumatic infections, peritonitis, empyema, cellulitis, erysipelas, broncho and contagious pneumonia of horses, and cerebro-spinal meningitis. 10 cc., used as a prophylactic dose, may prevent strangles and influenza in horses and septic arthritis in calves exposed to the disease; and a full dose, during influenza, may avert purpura as a sequel. As some of the above diseases are often caused by infections other than streptococcus, the employment of antistreptococcic serum may be unavailing in them unless the etiology is known to be streptococcic invasion. On the other hand, any form of horse serum increases the resistance to infection and, according to Metchnikoff, is more valuable than bacterial vaccines to stimulate antibodies and phagocytosis. This may explain why antidiphtheric serum or antitoxin is useful in influenza as well as antistreptococcic serum.

Anti-streptococcic serum is especially useful in septicemia of the new-born, derived from navel infection, and attacking foals, calves, and lambs. As a preventive in endemics 10 cc. should be given at birth and, for treatment, 10 cc. should be injected daily—in addition to care of the navel and joints.

Dosage.—In the larger animals from 20 to 55 cc. are injected at

all ages at a single operation, and the dose should be repeated every 12 or 24 hours until symptoms abate.

A fresh specimen of antistreptococcic serum is always desirable, as its power to destroy streptococci is soon lost.

Hog Cholera Serum.

The prophylactic treatment of hog cholera and the treatment in the early stages of the disease by serum is now on a firm basis.

The serum is made by hyperimmunizing immune hogs (those which have recovered from the disease) with intravenous injections of blood serum from hogs sick with hog cholera. After a week or so has elapsed the hyperimmunized hog is bled and the serum from this hog (mixed with 0.5 of 1 per cent. phenol) is employed in prophylaxis and treatment of the disease.

It is given subcutaneously into the thigh by two methods:

1. The simultaneous method by which the sterile serum from a sick hog (with 0.5 of one per cent. phenol) is injected together with the serum as above prepared.

The serum is taken from hogs which have been inoculated with hog cholera and which sicken on the seventh day and are about to die on the fifteenth, to avoid securing blood contaminated with other infections. The doses by the simultaneous method are in a general way 1 c. c. of virus (serum from the sick hog) injected with 35 c. c. of the immunizing serum for hogs of 50 to 75 lbs. weight, or in this ratio of 1 to 35 for all hogs over 50 lbs. Young pigs should be injected by the simultaneous method when 10 or 12 days old and when 3 months old, to secure immunity for life. At the first injection the pigs receive 0.1 to 0.2 c. c. of virus with 8 to 10 c. c. of immunizing serum, while at the second injection they should weigh about 50 lbs. and receive 1 c. c. of virus and 20 c. c. of immunizing serum.

The doses of virus and serum for young pigs, as given by Salmon, are as follows:

Pigs	Virus	Immunizing Serum
2— 3 lbs.	.05 c. c.	5 c. c.
3— 6 lbs.	.1 c. c.	8 c. c.
6—10 lbs.	.2 c. c.	10 c. c.
10—15 lbs.	.3 c. c.	15 c. c.
15—25 lbs.	.4 c. c.	20 c. c.

In the case of animals to be slaughtered within a month or so the use of the immunizing serum alone will afford sufficient protection.

Thus immunization of the animal is made permanent but the animal is given a mild form of disease and may therefore communicate a virulent form to unprotected hogs.

2. The immunizing serum is injected alone, in doses varying from 5 to 10 cc., for 75 lbs., live weight, for animals which have not been exposed; and 20 cc., per 50 lbs., live weight, for animals which have been exposed. The immunizing serum gives a transient, passive immunity lasting some weeks, unless the animal becomes shortly exposed to hog

cholera when the immunity becomes lasting. The serum is supplied free by certain states and also is prepared by makers of biological products.

Statistics show that the immunizing serum protects hogs to the extent of 100 per cent., if given just before exposure has occurred, the immunity not being permanent. In herds which have been exposed, of those inoculated with serum only 4 per cent. die, while of those untreated 90 per cent. perish. In herds, in which hog cholera already exists, of the inoculated 15 per cent. died, as against 75 per cent. among the uninoculated. As a curative agent it is not so satisfactory, the result depending on the day of disease in which it is used. At the outset it is very successful, in doses of 40 or more cc. per 100 lbs., and is the only remedy which offers any promised success.

Bacterial Filtrates.

Tuberculin.—Koch's tuberculin is prepared by growing tubercle bacilli in flasks, containing peptonized bouillon and glycerin, in an incubator at 37° C. for six weeks. The cultures are boiled and filtered through porcelain to remove the dead bacilli, and the toxic substance is concentrated to one-tenth of its bulk by boiling. The result is a solution of the endotoxins of the tubercle bacilli in glycerin, and to this is added a ½ per cent aqueous solution of carbolic acid for injection. Tuberculin is used in veterinary medicine solely as a diagnostic test for tuberculosis in animals, chiefly cattle. It may be used with almost entire certainty for this purpose, Koch claiming 99 per cent. of correct results from its injection. Injections in tuberculous animals cause a rise of temperature of from one to three or more degrees F. in about twelve hours from the time of injection. If there is any focus of tuberculosis, as in the joints or bones, open to inspection, there will be a notable reaction observed in this locality, with heat, redness and decrease of function of the part. Ehrlich formerly attributed the fever following the injection of tuberculin to a reaction of the zone of cells about the tuberculous focus which are made unusually susceptible by the toxins of the disease so that they become inflamed by the sudden extra amount of toxin injected. In a tuberculous guinea pig, which has been killed by the injection of an overdose of tuberculin, zones of hyperemia may be seen surrounding each of the gray nodules characteristic of the disease. It is now believed that the fever in the subcutaneous tuberculin test, and the local redness and swelling at the site of application in this and in the eye and skin tuberculin tests, are due to anaphylaxis or serum disease.

Anaphylaxis means the hypersusceptibility to a toxin or foreign proteid by an animal which has survived a non-fatal dose of the same substance. If repeated injections of a foreign proteid are made at short intervals, less than seven days, no untoward result occurs, but if

given at longer intervals than ten days then the outcome may be fatal in man and animals. Thus the serum from another species of animal injected into a patient after a long interval, following the primary dose, may cause slowing of the respiration, dyspnea, cyanosis, convulsions and death from paralysis of the heart muscle. Digitalis and atropine given under the skin are the best antidotes.

Vaughan explains the phenomenon of anaphylaxis on the assumption that when foreign proteids (antigen) enter the tissues unchanged the cells form enzymes (antibodies) capable of destroying the proteids. In their destruction the cleavage-products produce toxic symptoms.

Thus in tuberculosis the enzymes are already formed in the cells and on the injection of tuberculin there is a sudden production of cleavage-products, especially in the region of the sensitized cells of the diseased area, and at the site of injection. The reason the sensitization does not occur commonly till after a second injection of a serum, and after an interval of 7 to 10 days, is because the cells require time to form the specific enzymes which are thereafter stored in the cell to attack the specific foreign proteid whenever it enters the body unchanged. Sensitized animals split up proteids rapidly while in normal animals the proteid is split so slowly as to cause no disturbance.

In man the injection of horse serum (diphtheria antitoxin) has occasionally caused severe anaphylaxis and death, though the repeated injection of antitoxin at month intervals is the routine practice in many children's hospitals and no casualties have resulted. As most of the antitoxins are horse serum the repetition of injections of antitoxin in the horse at long intervals is not fraught with danger, since the serum is homologous, or natural to the animal. The same applies to the use of human serum in man. All animal serums, but that of the horse and rabbit, are toxic to man.

The injection of an ordinary dose of tuberculin is practically harmless and does not even render the milk of a cow unfit for food. In an advanced stage of tuberculosis the animal may not react to tuberculin, and this may be explained by the fact that the tissues are perhaps habituated to the toxins.

There are two other periods in tuberculous infections during which the animal does not react to tuberculin. These are the incubation and latent periods. Thus after an animal has become infected it may be two months before the animal will react to tuberculin. When tests are made every six months it frequently happens that, after two or more positive reactions occur in an animal, it may cease to react. The animal is then called a "ceased reactor." This follows because the lesions have healed through the curative action of the tuberculin injections or through natural agencies. Thus seven

animals reacted to tuberculin at two successive six month tests. They ceased to react to the following tests and were slaughtered three years after the last positive reaction. At this time all but one of the seven animals proved to be tuberculous at autopsy. They had healed lesions and the disease was in the latent or dormant state. Whenever there is a large percentage of reacting animals in a herd the non-reactors will be found reacting at later tests in considerable numbers. The only way to free a herd permanently from tuberculosis is to retest it every 2 months until there are no reactors. The annual and semi-annual tests allow incubative cases, not reacting at the previous test, to develop and communicate tuberculosis to other animals and so the disease is perpetuated in the herd indefinitely. It is always advisable to purchase animals from a herd altogether free from tuberculosis.

Moore of Cornell found in a herd of 491 animals that all reacted to the tuberculin test save 96 animals. These 96 non-reactors were segregated in non-infected quarters and tested every six months. At the end of four years only 19 remained which had not reacted to the tuberculin test. The explanation of these figures lies in the fact that some cows were in the incubation stage, that others became infected, and that in others a latent or healed lesion became active or open.

The Test.—It is best to take the temperature of the animal from 6 A.M. every two hours until the tuberculin is injected on the evening of the same day between 8 and 10 o'clock. The test is unreliable in animals whose temperature reaches 103.2° F. (except in the young, when this may be considered a normal, maximum temperature) during this period prior to the injection, and sometimes in those in advanced stages of the disease. The test is also misleading when the animal is "in heat" and within a few days of parturition, either before or after. The injection is made aseptically into the subcutaneous tissue in the side of the neck or back of the left scapula with a syringe and needle previously boiled. The animals should be kept in the stable during the time required for the test, and should not be allowed to drink large quantities of cold water to reduce their temperature while the test is being made. The temperature of the animal should be taken at 6 o'clock on the morning following the injection and from that time every two hours till 8 P.M.

A rise of two degrees F. is necessary for a positive reaction; that is, a rise of two degrees over the maximum temperature of the animal in the fourteen to sixteen hours before the injection. Those animals in which the temperature does not rise to 103° F. within fifteen or at most twenty-four hours after injection may be

considered non-tuberculous; when the temperature is between 103° and 104° F. the test is doubtful, and the animals should be re-tested after two months; when the temperature rises gradually to 104° F., or over, within fifteen hours after the injection, the animals may be classed positively tuberculous, provided the temperature constitutes a rise of two degrees over the maximum temperature recorded prior to the injection. Before admitting new cows to a herd they should be isolated until tested twice with tuberculin without reacting. This is necessary because cows may not react in the incubative or latent stage and because previous injection of tuberculous cows with tuberculin may prevent them from reacting to small doses. Therefore after a first test with negative result the cows are kept isolated for three months, when a second test is made with three times the first dose of tuberculin. Milk from these cows may be sold as certified milk during the isolation period.

Animals should be kept at rest before the tuberculin test is made. Tasteless antipyretics are sometimes put in food to prevent the action of tuberculin.

The average dose of tuberculin as prepared and diluted for immediate use by the U. S. Government is 2 c.c., representing 0.25 c.c., of old tuberculin. If tuberculin is to be kept for any period, it is better to procure the concentrated toxin and dilute it with a ½ of one per cent. carbolic acid solution prior to injection. In old and emaciated animals double the ordinary dose of tuberculin should be used, and in re-tests (as has been noted above) three times the usual dose of tuberculin should be injected. Tuberculin should be kept in a cool, dark place and should be rejected if it becomes cloudy. The dosage is adjusted somewhat to the weight of the animal. Yearlings and 2-year-olds may be given 1 to 1.5 c.c. Bulls and large animals may receive 3 c.c.

Ophthalmo-Tuberculin Diagnostic Test.—Simultaneously both Calmette of Lille and Wolff-Eisner of Berlin announced this test in June, 1907. It consists in dropping one drop of a 1 per cent. solution of tuberculin in the eye. In tuberculous subjects this is followed by hyperemia, lachrimation, and redness of the eyelids, which begins in about 3 to 8 hours, reaches the maximum in 8 to 14 hours, and remains 1 to 4 days. There is often edema of the lids and purulent discharge. The reaction is caused by an acquired anaphylaxis to tuberculin as shown by local leucocytosis and hyperemia. No harm results to the normal eye.

The solution is made by precipitating crude tuberculin with alcohol, the precipitate is collected and dried and dissolved in normal salt solution.

It is best to perform the test early in the morning to observe the

results. One should hold down the eyelid in making the instillation and gently massage the lids afterwards. If the ocular test proves negative on its first trial it may be repeated in the other eye after the lapse of three days. It should not be repeated much later than this, or one may get a reaction in the eye of any healthy animal owing to sensitization of the subject (anaphylaxis).

Tablets for dilution (and glass tubes containing single doses) of tuberculin for the eye reaction may now be bought of makers of biological products—together with the pipette and directions for using.

The eye test may be used in the case of newly-arrived animals, and in animals having fever, in pregnant animals, in those remaining out-of-doors and in those which have had a course of tuberculin treatment. A positive reaction may later be substantiated by the subcutaneous test with which it does not interfere.

Tuberculin especially prepared for the eye test contains no carbolic acid. The animals should be inspected on the 12th and 24th hour after the instillation for redness and swelling of the lid-conjunctiva with that of the haw and caruncle, and for increased vascularity and redness of the white of the eye and muco-purulent discharge.

Intradermic Method.—When tuberculin (2 to 4 m. of a 10 per cent. solution) is injected into the skin of one of the subcaudal folds in cattle, or at the base of the ear in hogs, a specific swelling and redness occurs in cases of tuberculosis. Moussu and Mantoux have shown that it is reliable and useful in that it is much easier to perform than the subcutaneous or ophthalmic tests. The injection into cattle is made in the skin of the middle or upper part of one of the folds, seen on lifting the tail, without any aseptic precautions. Within 24 hours an oval or elongated edematous swelling occurs about the size of a hazel nut or walnut, if the test is positive. This begins to diminish in 4 days and disappears in 10 days. In the non-tuberculous there may be a swelling as large as a grain of wheat. In comparing the two folds, on lifting the tail, it will be seen that the injected fold is twice or three times as thick as the other in positive reactions.

In the hog the injection is made into the skin of the base of the ear, after the animal is thrown as for castration. Within 4 to 48 hours a swelling the size of a hazel nut or walnut appears behind the base of the ear surrounded by a red areola as large as the palm of the hand while, at the site of injection, there appears a bright-red area growing as large as a quarter dollar in unpigmented skins, when the test is positive. The reaction begins to diminish on the third day and disappears by the 15th day. In non-tuberculous animals

occasionally some swelling and redness occurs within an hour at the site of injection but this disappears entirely at the time the positive reaction is at its height (24 to 48 hours).

Luckey* believes both the eye and skin tuberculin tests unreliable but finds the intradermal test fully as accurate as the subcutaneous test and preferable to it in being suitable for all animals, old and young alike, without regard to circumstances unfavorable for the temperature test. Thus animals "in heat," recently in calf, advanced in pregnancy, or those heated and excited are suitable for the intradermal test. The great saving in time, in not taking temperatures, makes the test much more simple and economical than the old test. In the testing of 3458 animals, checked by 103 autopsies, there were but three errors. Luckey thinks it unnecessary to pick up the caudal fold but injects about three minims of tuberculin through a medium sized needle wherever, in this vicinity, the skin is soft and pliable. The needle should be thrust just as near the surface of the skin as possible and yet not allow the tuberculin to escape. Three days later the animals are examined.

Cutaneous Test.—In the ordinary skin reaction (Von Pirquet's Test) a drop of 25 per cent. solution, or pure, old tuberculin is rubbed on the abraded skin, as in human vaccination. Within 24 or 48 hours a papule forms at the site of the test, surrounded by a zone of hyperemia, if the reaction is positive.

SIGNIFICANCE OF THE VARIOUS TUBERCULIN TESTS.

It is commonly taught that reactions to the different tests have different values. Thus the subcutaneous test is properly regarded as the most reliable, in showing active lesions, but it is often stated that a positive reaction sometimes is observed in a tuberculous lesion long healed (Hare). Again, in regard to the eye test, it has been reported positive in 18.5 per cent. of normal subjects and negative in 20 to 30 per cent. of known tuberculous lesions, active or otherwise.

The skin test is so often positive in humans that it is considered of little value in showing an active lesion, except in children. A lesion existing in the young may be considered active since it is of recent origin.

But it is probable that a fully healed tuberculous lesion will never cause a positive tuberculin reaction in any of the tests. The reaction is caused by antibodies which are brought into existence by the toxins of tuberculosis. As long as these toxins escape into the circulation so long will the antibodies be formed. But when the lesion is healed, or shut off completely by encapsulation and no toxins

* Amer. Vet. Review, June, 1912.

enter the circulation, then, or within a short period thereafter, will reaction to tuberculin cease. Rapidity of reaction to any of the tuberculin tests is most important as showing the activity of the lesion.

Thus a test which gives a maximum reaction within, or as early as 12 hours, indicates an active lesion. While a test in which reaction begins in 24 hours and is at its maximum on the second or third day signifies an inactive or latent lesion. Sometimes a very marked reaction occurs during these later hours.

Mallein.—This is made, like Koch's old tuberculin, by sterilizing and filtering a culture of B. mallei to remove the dead bacilli. It is an extract containing the toxins. The usual diagnostic dose is one c.c. (as prepared by the U. S. Bureau of Animal Industry) for the average sized apparently healthy horse, but a larger dose (not to exceed 2 c.c.) should be given to suspicious cases, and to extra large horses, and weakened and old animals. Small animals may receive a proportionately smaller dose. Animals with acute diseases or those with suppurating lesions are unfit subjects for the injection of mallein.

The actual mode of making the test is as follows: The temperature should be taken at 2, 5 and 8 P.M. and a careful clinical examination should be made and the animal numbered or lettered, if several are to be tested. In suspicious cases a separate syringe and thermometer should be used for each patient and, in other cases, the syringe, needle and thermometer should be sterilized each time before using, the latter by washing and immersion in alcohol and then 5 per cent. carbolic solution, while the syringe and needle should be boiled. The hair should be clipped from the side of the neck over an area 3 inches in diameter and if the temperature does not exceed 101° F. on the three occasions it has been taken, then on the evening of the same day (8 to 10 P.M.) mallein may be injected aseptically under the skin of the neck. Temperature recording should be again begun 10 hours from the time of injection and be continued every 2 hours for a period of 20 hours, and longer where the temperature is rising and there is a local reaction as well. The following rules for condemning an animal have been adopted by the U. S. B. A. I.

1. In order that a reaction produced by mallein may be considered positive it should evince the characteristics of a typical reaction; that is, a combination of thermal, local, and general reactions.

2. By a typical reaction is to be understood a gradual rising of temperature at least 3° F. and to above 104° F., the maximum temperature being sustained in the form of a single or double plateau. It should be accompanied by a local as well as a general reaction. The local reaction consists of an infiltration at the site of injection

forming a large, abrupt, painful swelling, with radiating lymphatics appearing as raised cords, generally attaining greatest prominence at from 18 to 21 hours after injection. The general reaction is exhibited by a stiffened gait, depression, loss of appetite, and accelerated breathing.

3. The presence of a local reaction, especially when associated with a general reaction, should be regarded as an evidence of glanders, even if the thermal reaction be slight or absent.

4. Animals giving an atypical reaction and those reaching a maximum temperature of 103° F. should be retested after the expiration of not less than 15 days. In the normal animal, a swelling occurs at the site of injection, without rise of temperature, but the swelling is much smaller and has almost disappeared at the end of 24 hours, whereas in the glandered animal the swelling persists until the third or fourth day.

The U. S. Bureau of Animal Industry has recently (1914) announced that the opthalmic mallein test for the diagnosis of glanders is as accurate and simpler than any other. Several drops of undiluted raw mallein (prepared for this purpose) are dropped in one eye of the suspect with a medicine dropper. The same dropper may be used for all animals in one stable.

All animals show immediately some reddening and lachrimation. The true positive reaction begins in 5 hours and lasts 24 to 36 hours with swelling and gluing of the lids, and a purulent discharge which is the important point. There may be only a little pus at the inner canthus. The severity of the reaction has no relation to the extent of the disease, however. Examination of the eyes in a good light should be made 12 to 24 hours after the instillation of mallein. There may be fever occasionally, and a rise of 1.5° F is in itself a positive reaction.

If, during the test, only tears and mucus are secreted it is negative. If the test is doubtful it may be repeated once within 24 hours in the same eye, but not again for 3 months. In doubtful eye tests the subcutaneous, agglutination or complement-fixation tests should also be employed.

After several mallein injections glandered animals may cease to react and such have been thought cured. Rutherford has shown that these "ceased reactors" not infrequently communicate glanders to healthy animals.

When the mallein reaction is not typical and doubt exists as to the presence of the disease the animal should be quarantined and the complement fixation test applied. Also when apparently normal animals react they should be given the complement fixation test since a certain percentage of such harbor parasitic nodules (not glanders) in the liver and lungs which are wholly harmless. The results of the mallein reaction were satisfactory in 89 per cent. of all tests in 6,870 cases (Mohler and Eichorn).

Specific Vaccines.

Vaccination consists in introducing, within the animal body, bacteria (or their products) of a disease—with the intention of protecting the animal against the disease. The beneficent action of vaccines is produced by modifying the virulence or action of the bacteria in some way, whereby antibodies are developed in the inoculated animal. These not only prevent the occurrence of the inoculated disease, but even the development of disease thereafter when introduced by natural channels. The activity of bacteria is lessened in various ways. Thus in preparing the vaccines against anthrax and blackleg the bacteria are exposed to heat. Then by inoculating the bacteria in a way, different from that in which they naturally gain entrance to the body, their activity may be diminished; *e.g.,* the bacillus of blackleg is introduced under the skin or intravenously, and the tail is sometimes chosen as a site, the blood supply being poor. The vaccines of blackleg and anthrax do not prove curative if employed after the development of the disease, against which they are preventives, and often they are ineffectual if used after the exposure of the animal to the disease. This is not the case in antirabic inoculation, however, as the treatment proves successful after the patient has been bitten and infected by a rabid animal. So in smallpox in the human, vaccination will modify and possibly prevent smallpox if done within four days after exposure to infection. The duration of the period of immunity conferred by vaccination differs in the case of the different vaccines.

Blackleg or Quarter Evil.—This disease is caused by B. Chauvœi and is distinct from anthrax. Calves should be vaccinated when six months old and again within a year. The best time is that before the usual occurrence of the disease, and no surgery, as branding, castration, marking, dehorning or spaying, should be done before, or within two weeks after, vaccination. Vaccination is done with a powder obtained by drying and triturating a piece of affected muscle and heating. Either one or two vaccines are used, the first being the weakest and prepared by heating to 103° and the second being heated to 93° C. and used eight days later. The Chief of the Bureau of Animal Industry, U. S. Agricult. Dep't., Washington, D. C., supplies gratis to stock owners black leg vaccine and directions for using the same. One dose given subcutaneously is usually sufficient to protect the animal for life against black leg, if used after the animal is 6 months old. In localities where the disease develops in younger animals the vaccine must be given at an earlier age and—in these cases—repeated the following year.

Immunity begins in 10 to 12 days following vaccination.

Anthrax.—Anthrax is the most fatal disease attacking horses, sheep, goats, mules and cattle. It occurs in the United States, more often in Mississippi and Louisiana. Vaccination was done by Pasteur in 1880 and was the first attempt made in establishing artificial immunity in practice. Great crowds gathered to see the result of his treatment. He subjected 24 sheep, 1 goat and 5 cattle to vaccination, and then 60 animals (including the vaccinated and unvaccinated) were inoculated with anthrax. Forty-eight hours later the sight presented to the public beggars description. In the paddock were seen dead and dying all the unvaccinated animals, while the vaccinated ones appeared in perfect health. A small number of animals—especially sheep and goats—die from the treatment. In countries where anthrax is endemic, vaccination has reduced the mortality from 10 to ½ of 1 per cent. Statistics also show that less than 1 per cent. of vaccinated animals die of the disease. When unvaccinated herds are attacked usually 80 per cent. die. The vaccination should be usually practiced in summer or fall, as these are the favorite seasons for development in infected regions. The protection lasts from six to twelve months. Two vaccines are used. Number one, the weaker, is made by growing bacilli in a current of air at 109° F. for twenty-four days; number two is prepared in the same manner during twelve days. After growth at this temperature the cultures retain their attenuation when grown for vaccines at body heat (98.6°). The weaker number one is injected and followed in ten days by number two. Sick animals may infect a pasture for ten years, but vaccination will practically permit of pasturing on the infected land. The method of inoculation requires minute directions, which may be obtained from manufacturers of biological products.

There are some other specific vaccines which are yet in the experimental stage but promise much. Thus cultures of the dead bodies of B. bronchisepticus of Ferry which are prepared by Parke, Davis & Co., will prevent canine distemper if given one month before exposure and, combined with the vaccine of staphylococci and streptococci, will cure the disease after it has made its appearance, according to Ferry in a personal letter to the author. The prophylactic doses, one month before exposure, consist of 3 doses at 3 day intervals of 350, 700 and 1,000 million specific organisms. Treatment after exposure, or as soon as diagnosis of distemper is made, is carried out with 175 million of the combined organisms—increasing the dose every three days by 175 million and using but half this dose for very small dogs.

A streptococcus vaccine made from S. equi of strangles given in the dose of 1 to 2 cc. will apparently act as a valuable prophylactic agent in that disease. Vaccination against strangles, influenza and contagious pneumonia is made with a polyvalent vaccine consisting of

staphylococci, streptococci and pneumococci which are found as secondary infections in the first two diseases and may aid in preventing the more serious complications. As a prophylactic remedy for influenza, strangles or pneumonia, 3 doses of 1,000, 4,000 and 6,000 million of these combined organisms are injected at 3 to 5 day intervals (½ this dose for colts). After exposure, or after these diseases are actually present, the dosage is about 300 million—gradually increasing according to the symptoms. A vaccine prepared from the various strains of streptococci from septicemia of calves will prevent that infection if given 24 hours after birth. Vaccines made from the dead bodies of micrococcus melitensis seem to offer protection against that disease.

The matter of vaccines is still in that experimental stage when one cannot lay down positive statements concerning the indications, dosage, results and other details which are desirable in a text book.

General Vaccine Therapy.

By General Vaccine Therapy we refer to the use of so-called vaccines, or bacterins, for infections generally. These vaccines are suspensions of killed bacteria in sterile salt solution. The vaccines may be used against any given infection by injecting subcutaneously small doses of the killed bacteria of the same species as that causing the infection. Thus in the case of staphylococcus infection one must know by examination of pus from the infection what variety of staphylococcus is causing the trouble and use the killed germ of that same variety of staphylococcus in order to get the best results. This treatment is based on the fact that the injections of the dead bacilli and their toxins stimulate the formation of antibodies in the serum of the patient—more particularly opsonins—and probably bacteriolysins and agglutinins as well. These antibodies further act by enhancing phagocytosis or the power that the leucocytes have to enclose and destroy bacteria—apparently by some action on the bacteria. The antitoxins and antisera contain antibodies, which are immediately imparted to the patient on their injection and so confer a temporary and passive immunity. The vaccines, on the contrary, act to stimulate the production of antibodies, and tend to confer an active and permanent immunity. The earliest and simplest form of vaccine treatment is autogenous and coeval with the existence of animals themselves. This consists in the licking of wounds. Absorption from the mouth and alimentary tract gives rise to specific antibodies in the serum. The wounds which heal most badly in cats and dogs are those about the head where they cannot be licked by the animals. But if, in these cases, a little wound dis-

charge is given by the mouth, according to Duncan, then wound healing becomes good. Acting on these premises Duncan * gives to human patients with recent infected wounds a few drops, by the mouth, of the early serous or purulent discharge from the wounds, without causing infection in the throat and with reported success. In acute general infections the use of vaccines is generally not so successful, since in them there is already enough toxin in the blood (causing fever and other symptoms) to enable the patient to produce his own antibodies and so to recover. But some systemic infections have been successfully treated with vaccines, as puerperal infection, pyemia and septicemia. Local infections are more amenable to vaccine therapy, but treatment should be begun early before a mixed infection occurs and before the part becomes surrounded by an impermeable barrier of pyogenic membrane or bacteria. Thus staphylococcus infection, causing boils, acne and local suppurations; pneumococcus infection, producing empyema, cystitis, etc.; colon bacillus infection, inducing cystitis and other local infections, have been apparently cured by injections of vaccines. Sir A. E. Wright, of London, who has introduced the vaccine treatment of infections to the medical profession, believes that the treatment should be guided by the opsonic index. This means practically the comparison of the power of leucocytes to invest bacteria in the serum of the patient, with the same action of leucocytes on the same bacteria in the serum of the normal person or animal. Thus 100 leucocytes may ingest 500 staphylococci in the presence of healthy serum. Employing the serum of an animal with furunculosis, 100 leucocytes may take up but 250 staphylococci. The opsonic index of the healthy individual is regarded as one and that of the example quoted would be 0.5.

The determination of the opsonic index is an elaborate procedure and is not essential for vaccine treatment. In a general way, after the injection of vaccines, the power of phagocytosis is lessened, but, after a few days, it is increased. So that injections are commonly made every 4-10 days or so, or after any general or local symptoms—caused by the injections—have passed. In systemic infections it may be necessary to inject daily, to secure the formation of antibodies, and the patient may be too depressed to be stimulated by the vaccines at all.

Both antisera and vaccines may be used at the same time, as antistreptococcic serum and streptococcus vaccine. Then comes the question of the source of vaccines. They may be prepared from bacterial cultures obtained from locally infected tissue, or discharges, or from the blood of the patient (autogenous). Or stock vaccines may be used which are now sold by makers of biological laboratory

* N. Y. Med. Record, Sept. 16, 1911.

products, that is, vaccines kept on hand ready-made. The autogenous vaccine is theoretically preferable in securing just the strain of infecting bacteria.

Now in regard to the use of vaccine in veterinary practice. While the preceding facts form the basis of vaccine therapy yet more experience with the treatment has caused us to modify our views and to ignore some of the requirements hitherto accepted as essential. Under this head we may consider the following points: 1. The necessity for isolation of the specific organism responsible for the infection. 2. Knowledge of the exact number of killed bacilli which is given at a dose. 3. The avoidance of reactions. 4. The uselessness of vaccine treatment in acute infections.

1. While the discovery of the infecting organism is theoretically necessary yet as a matter of experience it has been found not to be essential for successful vaccine treatment, in many cases. In the ordinary wound infections, for example, the infection is usually mixed or due to several common organisms. The predominating bacteria are the Staphylococcus albus, aureus and citreus, Streptococcus pyogenes of many strains, B. coli communis and some others, as B. pyocyaneus. Stock vaccines made from pus often act very favorably in wound infections. Indeed some surgeons affirm that they get better results from mixed varieties of the same species of organism, or what is called a polyvalent stock vaccine, than from a pure culture of the infecting organism, or organisms, derived from the patient. In urinary infections in which the B. coli communis commonly preponderates, with also the staphylococci and other bacteria participating, in many cases a mixed vaccine containing the above organisms has often proved satisfactory.

2. An arbitrary dosage is not of so much importance as it has formerly been thought for the reason that individuals vary so in response to the action of vaccines. The writer has noted such a difference in the susceptibility of two patients with colon infection of the urinary tract that one required a hundred times greater dose of killed bacteria to produce a reaction than the other. It is feasible to inject a small amount of vaccine, without knowing the number of contained bacilli, and thereafter to regulate the dose according to the action on the patient.

3. It has been commonly taught that one should avoid marked reactions but it has been found that patients often do very well after such. This remark includes both the local reaction, consisting of swelling and heat at the site of injection, and the general reaction —which includes anorexia, depression, stiffened gait, rapid breathing and possibly slight fever.

The essential point in spacing the doses consists in waiting till the local reaction has wholly subsided and the general reaction has entirely passed away before the dose is repeated (4 to 10 days). On the other hand the dose may be repeated to advantage and doubled in amount every 2 days until either a marked local, or general reaction, is observed. Then the dosage may gradually be increased until another reaction occurs.

4. The production of antibodies is often progressing at the highest point in acute general infections and, at other times, the leucocyte count is low and the system is so overwhelmed by toxins that there is no attempt at bodily repulse. In neither of these cases are vaccines indicated. They are, however, often prophylactic when given to patients likely to be exposed to acute infections, as in the case of the B. bronchisepticus of canine distemper and in streptococcus infection of strangles, and in the case of typhoid fever in man.

In some acute infections where the body is not producing all the antibodies possible vaccines may be used to stimulate their production and in these cases the leucocyte count is the best guide taken 4 hours before and 8 hours after vaccination. If the count is increased by the vaccine one may wait several days and then double the dose; if the leucocyte count is not increased then one may increase the dose on the following day.

In acute wound infections the use of vaccines is undoubtedly of value. Indeed Jewell* affirms that vaccine treatment is as useful in acute as in chronic wound infections and that, if employed in all infected recent wounds, healing will progress in half the usual time —providing proper drainage is secured and necrotic tissue and foreign bodies are removed from the wound. Jewell finds Kinsley's method of making vaccines most simple and satisfactory for the treatment of recent and serious infected wounds, especially those of tendons—sheaths and joints, and in punctures about the feet of horses. The vaccine is also applicable in more chronic suppurative conditions, as in fistulous withers and poll evil. Jewell has followed an arbitrary rule which is to give 2 c.c. of Kinsley's vaccine under the skin at the side of the neck at the earliest moment of infection and to give another dose of 4 c.c. after 4 days. He states that not more than two doses are commonly needed for cure. If, however, a cure does not at once follow he gives, at 4 day intervals, 2 c.c. doses of the vaccine. Local and general reaction does not deter him from continuing the treatment until pus disappears from the wound. Kinsley's method is as follows: A culture medium is prepared from

* Amer. Vet. Review, Oct. 1911.

Liebig's beef extract, 2 gms; soluble peptone, 10 gms; pure sodium chloride, 5 gms; water, 1 litre.

Boil 2 or 3 minutes, test to see if it is neutral or slightly alkaline. Filter through ordinary filter paper and place in 100 c.c. sterile flasks. Sterilize the flasks and contents at 212° F. for 15 minutes on 3 consecutive days. Take a sterile platinum loop and place two loopfuls of pus from a wound, not treated with vaccines, into a flask of culture medium. The flask should then be incubated at 38° C. for 48 hours and taken out and sterilized for one hour at 60° C. in a dry sterilizer. To each 100 c.c. of the product add seven drops of phenol as a preservative. The product or vaccine is placed in sterile vials holding 2 c.c. and 4 c.c., both the corks and vials being previously sterilized at 160° C. for one hour by dry sterilization. The corks are dipped in melted paraffine and the vials sealed with them. In making the vaccine one can judge of the activity of the culture by observing the growth on the medium and also by examining smears of the vaccine under the microscope. All that is necessary is a good growth and the exact number of killed bacteria per c.c. is not ascertained. In using this method one may use a box enclosing a small electric light, for an incubator, and a wash boiler with gas heating for dry or steam sterilizing.

Mangan has pursued the method of Duncan in veterinary practice (Amer. Vet. Review, July, 1912). He believes that organisms grown in a culture medium have less effect in stimulating immunity than those taken directly from the patient. He uses 15 Cc. of pus, or scrapings of necrotic tissue when pus is unobtainable, taken from the wound which is to be treated.

This is shaken with 180 Cc. of water in a brown bottle to disguise the contents. The dose of the mixture is 30 Cc. hourly for 4 doses, by the mouth, repeating the same every fourth day. Or 1 to 3 Cc. of pus (according to its density) are shaken with 20 to 30 Cc. of water and kept at room temperature for 10 hours, shaking the mixture occasionally.

This mixture is then placed in a Berkefeld filter (No. 3-N-Med.). The filtrate is kept in a sterile container and from 1 to 2.5 Cc. are injected subcutaneously every four days, or as circumstances dictate. Mangan has had great success with this treatment in badly infected wounds of horses in a limited number of cases and it certainly has simplicity to commend it.

There are various forms of stock vaccines on the market. The H. K. Mulford Co. put out the following vaccines in glass ampuls, each representing a single dose of which part may, however, be used. 1. Colon bacilli in, 2, 4, 8, 12, 16 and 20 hundred million killed bacteria in separate ampuls. The initial dose is from 1 to 4 hundred

million bacteria and the vaccine may be used especially in urinary infections and infections connected with the digestive tract. 2. Staphylococcus vaccine. This contains polyvalent strains of the three common species of staphylococcus from equine sources. It is prepared in about the same doses as the colon vaccine and the initial dose is from 2 to 4 hundred million. This vaccine is useful in abscess, fistulæ, poll evil, quittor, boils, acne, and suppurating lesions. 3. Streptococcus vaccine. This is a polyvalent streptococcus vaccine prepared in the same doses as the colon vaccine and the initial dose is from 1 to 4 hundred million. It is indicated in spreading infections as erysipelas, cellulitis, lymphangitis, strangles, fistula and poll evil, etc. 4. A mixed vaccine, containing from 200 million to 6 billion polyvalent streptococci, mixed with from 1 to 6 billion of the three species of staphylococci, in six separate ampuls, each containing a single dose. This vaccine is perhaps most useful, especially when the infecting organisms have not been isolated. The initial dose is 1 billion staphylococci with 200 million streptococci. It is indicated in all wound infections, fistulæ, poll evil, parturient infections, septic omphalitis and arthritis of the new born, strangles and cellulitis.

Parke, Davis & Co. prepare vaccines for veterinary use consisting of 100 to 500 million killed bacteria in tablets for hypodermatic use. These represent four formulæ: 1. Combined varieties of staphylococci. 2. Streptococcus pyogenes. 3. Streptococcus pyogenes with the three species of staphylococci. 4. Colon bacilli. The use of vaccines representing the specific organism of various diseases is in its infancy but the future is bright with promise, especially as prophylactic agents.

The subcutaneous injection of minute and gradually increasing doses of tuberculin (1/2000 to 10 mgm.) as treatment for tuberculosis in human medicine—now much in vogue—is an example of vaccine treatment to stimulate antibodies in the serum of the patient. Sometimes only the toxin of the tubercle bacillus is used (Koch's old tuberculin) and sometimes a suspension of killed tubercle bacilli.

Strangles is caused by a specific streptococcus (s. equi). The use of vaccines of killed streptococci will induce immunity to the disease. The disease may also be prevented, and even cured in its early stage, by immunizing serum obtained from horses receiving increasing doses of the specific cocci. The latter are sometimes protected against the immediate effects of the streptococci by immunizing serum.

This method of combining the use of a protective serum and injections of active bacteria is now being employed against rabies, anthrax and rinderpest. The immunizing serum in rinderpest is ob-

tained from animals recovering from the disease and the protective value of their serum is much augmented if these animals are injected with blood from animals affected with a fatal form of rinderpest.

In rabies the combined method of injecting active organisms and protective serum bids fair to supersede the Pasteur method of prolonged vaccination, as but one injection may suffice and the treatment may be given at a much later stage of incubation to protect from the disease. The immunizing serum for this method is obtained from sheep receiving intrajugularly and subcutaneously increasing doses of an emulsion of the brain of a dead, rabid rabbit. When an animal is bitten by a rabid patient the bitten animal is given subcutaneously an injection consisting of the protective serum, made as above, and an emulsion of brain from a rabid rabbit. Reports have been most favorable and in epidemics of rabies immunization of all animals by this method may be required in the future.

In anthrax also the combined, or simultaneous, method is said to be yielding much better results than the double inoculation with the weak and stronger vaccine of Pasteur.

AN EPITOME OF MODERN TREATMENT OF DISEASES OF THE DOMESTIC ANIMALS.

For details concerning the use of drugs or measures recommended in this section the reader is referred to the text of this book.

ABORTION.

(1) Accidental, all animals; (2) Epizoötic, in cows and ewes. The complement fixation test is useful in diagnosis. Ingestion of food contaminated with infected vaginal discharge is chief source of the infection. 1. To prevent, give opium; rest, laxative diet. 2. To prevent contagious abortion all the herd should be given ½ ounce of methylene blue in capsules with balling gun twice daily (during the whole period of pregnancy), for seven day periods, with intervals of 4 weeks when the drug is withheld. Isolate, burn fetus and membranes; disinfect premises; empty uterus. Antiseptic vaginal injections; lysol, creolin, carbolic acid, corrosive sublimate. Separate attendant and utensils; patients must not go to bull till vaginal discharge ceases; bull apt to become infected and if has balanitis is unfitted for service of healthy animals. Animals which have aborted may be wlsely fattened for market.

ABSCESS.

To abort, paint with tincture of iodine; or inject 10 or more m. of 2 per cent carbolic acid solution; poultices, fly blister, open with knife or actual cautery under ethylchloride spray, and cocaine. After opening, inject antiseptics, as hydrogen dioxide, and iodoform with vaseline or glycerin. To aid resolution, a blister of cantharides, vaccines.

ABSCESS, COLD.

Open with actual cautery or knife; inject antiseptics, as carbolic acid in glycerin; Peruvian balsam. Dress with powder, equal parts of tannic acid, boric acid, iodoform and charcoal.

ACARIASIS. See *Mange*.

ACNE.

Prevent by avoiding rough harness and by constant cleansing with sulphur soap after removal of harness. Abort by applying pure carbolic acid. When acute, hot fomentations with borax, 3 ii-Oi; dry sulphur, sulphur ointment. Fowler's solution in chronic cases. Vaccine of acne bacilli and staphylococci in obstinate cases.

ACTINOMYCOSIS.

Chiefly in young cattle, affecting the jaw and tongue, soft parts of head, pharynx, larynx, skin and internal organs. Excise, curette, chisel. Apply tincture or compound solution of iodine to wound, or iodoform. Large doses of potassium iodide internally; good food and tonics.

AFTER-PAINS.

Remove membranes and clots; opium, morphine. If fever and foul vaginal discharge are present, see *Puerperal Fever.*

AGED ANIMALS, destruction of.

Strychnine, bullet, chloroform, prussic acid.

ALOPECIA (BALDNESS).

If general, due to debility, give good food, iron, arsenic, bitters; and apply to skin tinct. cantharis, ʒ i; lin. saponis, ʒ viii. With scaling, use sulphur ointment, and add later to it Peruvian balsam; also groom very thoroughly. In alopecia areata, use ung. chrysarobini; or equal parts alcohol and tinc. iodi; or creolin and alcohol (1-10-20); or balsam of Peru and alcohol (1-10).

AMAUROSIS.

Treatment depends on cause. If owing to debility, loss of blood, trauma or quinine poisoning, give strychnine internally; and apply fly blister about temples. In amaurosis due to cerebral disease (concussion, hydatids, parturient apoplexy), to renal disorder, convulsions, lead poisoning, etc., treatment depends upon the causative factor.

AMMENORRHEA. See *Sterility.*

ANEMIA.

Remove primary cause. Full diet; fresh air and exercise; comfortable housing; sodium chloride and HCl; iron, arsenic, quinine, gentian, strychnine, cupric sulphate. Cod liver oil, myrrh. Clip horses with thick coats. In pernicious form, Fowler's solution in increasing doses till the maximum dose is reached; H., ʒ ii twice daily; D., ♏xxx thrice daily.

ANEMIA, Infectious, of Horses, Asses and Mules.

Treatment is purely symptomatic and is not very successful. Give antipyretics for fever: acetanilid 3 ii and quinine sulph. gr. 40 t.i.d. sodium cacodylate, gr. xxx every other day subcutaneously. When fever subsides give pulv. ferri sulph 3 ii, acid arsenosi gr.2, quin. sulph. gr.xxx, pulv. nucis vom. 3 i, pulv. gent. ʒ i; M. et f. pulv. I.; give one such t.i.d. Give laxative food and daily enemata of cold water to excite peristalsis and reduce fever.

ANEURISM.

Radical cure by ligation of aneurism on either side of sac and excision of sac. When impossible, ligate proximal side. Employ Matas' operation, in which temporary ligation on either side of sac and obliteration of orifices and sac with layers of buried chromic gut sutures are done and continuity of vessel remains intact. Continuous pressure by hands or truss; potassium iodide; ergot injections into sac in early stages; needling; acupuncture; introduction of foreign bodies into sac, as wire.

ANOREXIA (APPETITE, loss of).

Gentian, cinchona, quinine, quassia, cascarilla, calumba, taraxacum, hydrastis, hydrastine, hydrastin, calamus, capsicum. Remove cause as carious or sharp teeth, and digestive or general disorders.

ANTHRAX. CHARBON. In Cattle, Horses and Sheep.

Treatment is chiefly preventive; bodies of dead burned or buried 7 feet deep, with hide intact. Flesh of the dead may communicate the disease, if eaten. Isolate or kill patients; infected premises and discharges must be thoroughly disinfected; avoid infected pastures; anthrax vaccine confers immunity; medical treatment is generally unsuccessful and may lead to infection of attendants or other animals and therefore inadvisable. Internally, calomel and salts, in cattle, and carbolic acid or creolin in enormous doses have aided recovery in some cases; injection of 5 per cent. carbolic acid solution at many points in anthrax carbuncles has proven curative in human patients.

APHTHA. See *Stomatitis.*

APHTHOUS FEVER. See *Foot and Mouth Disease.*

APOPLEXY, CEREBRAL.

Raise head, ice bag to poll; venesection, 4-8 quarts in horse; veratrum. Mustard paste to legs and bandage; croton oil; dark, quiet quarters; gruels and mashes, if swallowing is possible. Change in position important; also use of the catheter and enemata. To aid resolution, potassium iodide, strychnine, massage and electricity.

APOPLEXY, PARTURIENT. In Cows.

Prevent by withholding grain last six weeks of pregnancy, except bran mashes; also give Epsom salts occasionally. Milk twice daily before parturition unless animal dry. Kunsel's treatment, successful in 90 per cent of cases. Enemata, ice to poll; bandage legs: prop patient up on sternum and change position every few hours. Catheterize and use enemata, caffeine, strychnine, alcohol, if collapse. Avoid drenches if animal unconscious; otherwise, give Epsom salts. For resulting paralysis, use potassium iodide; strychnine; blister over lumbar region; gruels and mashes during convalescence.

APOPLEXY, PULMONARY. See *Pulmonary Congestion and Edema.*

APOPLEXY, SPLENIC. See *Anthrax.*

APPETITE, DEPRAVED. See *Depraved Appetite.*

APPETITE, LOSS OF. See *Anorexia.*

ARTHRITIS.

1. In horses, traumatic and septic; 2, in new-born, due to umbilical infection; 3, may be variety of acute infection known as acute articular rheumatism; in this form use salicylic acid or salicylates; salol; externally, formalin and glycerin infections, methyl salicylate, sodium bicarbonate, iodine ointment; later stages, salicylates and potassium iodide; diet, milk for small, and gruels and mashes for large patients in acute stage. 2. When disease prevalent segregate pregnant animals. Ligate aseptically the cord of new-born at birth and sterilize the stump with tinc. iodine. As preventive, give new born within 24 hours of birth 10 c.c. antistreptococcus serum subcut. or specific vaccine.

Disinfect the stall before another birth occurs. May be due to B. necro-

phorous, staphylococcic, or other infection; see Umbilical Infection. In traumatic arthritis, cold irrigations or hot fomentations; internally, calomel; Priessnitz poultice; rest, splints and slings; later, blisters; red mercuric iodide; iodine. An arthritis may occur as a complication of almost any acute infection. Use formalin and glycerin in acute infections.

ASCARIDES. See *Parasites.*

ASCITES. See *Dropsy.*

ASTHMA, BRONCHIAL, IN DOGS.

In attack, chloroform, amyl nitrite, morphine, fumes of stramonium leaves and saltpetre, equal parts. Chloral, bromides, belladonna, potassium iodide, inhalations, arsenic, cod liver oil, between attacks.

AZOTURIA. See *Hemoglobinuria.*

BALANITIS.

Withdraw penis. Cleanse with lysol. If the urethra discharges, give urethral injection, 1 per cent. zinc sulphate and lead acetate mixed; hydrastis. Horse or bull may have to be cast and glans cleansed with lysol (2 per cent.) and touched with stick silver nitrate. Rest, cathartic and sloppy food.

BARRENESS, STERILITY.

Remove the immediate cause, if possible, after careful examination of body and generative organs. In the female, injection of yeast (cow) has given favorable results; one cake of fresh, compressed yeast dissolved in quart of tepid water, after standing 2 hours, is used as a vaginal injection once daily for a few days; the vagina should first be cleansed with soap and water. Aphrodisiacs, yohimbine, emmenagogues. Examine semen for spermatozoa. Exercise, reduce obesity (see *Obesity*). In debility, bitters, iron and good food. In female, change male; may try intrauterine injection of semen; dilatation of constricted os uteri.

BITES.

Of Snakes: Calmette's serum injected into muscle (10 c.c. human dose) very successful; immediate cautery with hot iron, or free incision of the bite, and ligature above the injury on a limb must be done. Inject 1 per cent. solution of potassium permanganate or 15 grains of chlorinated lime in 2 ounces of sterile water about the bite in several places; strychnine subcutaneously in enormous doses; and adrenalin.

Of Rabid Animals:—Cauterize with hot iron, nitric acid followed by saturated sodium bicarbonate solution and then by alcohol, or excise the bite, even 24 hours after injury; human patients should receive Pasteur's anti-rabic vaccine.

Of Insects:—Aromatic spirit of ammonia, potassa; or a 10 per cent solution of sodium bicarbonate should be applied to bite; also wet dressing, clay, antiphlogistine.

BLACK-QUARTER. BLACK-LEG.

Prevention secured by vaccine; avoid infected pastures; bury dead with hide intact, 7 feet below surface in quicklime; disinfect premises; free in-

cision of swellings (endangers spread of infection) and injection of hydrogen dioxide and other antiseptics in mild cases.

BLADDER, IRRITABLE.

Sloppy food, linseed tea. A cathartic; rest; hot enemata. Remove smegma, calculi and other sources of irritation. Belladonna, hyoscyamus, potassium citrate, potassium acetate, spirit of nitrous ether, camphor, buchu, salol, urotropin.

BLADDER, PARALYSIS OF.

Empty by sterile catheter or, in horse, pressure through rectum. Treatment directed to cause.

BLEPHAROSPASM.

Atropine.

BLEEDING. See *Hemorrhage.*

BOG SPAVIN. See *Synovitis.*

Rest; irrigation; hot fomentations; Priessnitz poultice; high heel shoe or slings, in bad cases; after acute stage passes, cantharidal blister.

BOILS OR FURUNCLES.

Aborted by touching with tincture of iodine, or pure carbolic acid, or painting with collodion, or 20 per cent silver nitrate solution; injection of 2 per cent carbolic solution. Puncture central opening with pure carbolic acid on toothpick and dress with carbolized vaseline; or creolin in Peruvian balsam (1-10); poultices inadvisable as they spread infection, Staphylococcic vaccine, for recurrence, internal remedies of doubtful advantage; calcium sulphide, H, gr. 20-30; D, gr. $\frac{1}{4}$-$\frac{1}{2}$, thrice daily; or sodium sulphite. or compressed yeast cake, 1 daily to dogs in pills. In anemia, bitters, iron and arsenic. Paracentesis in severe cases; dress with Peruvian balsam and creolin, as above, or iodoform, and avoid chafing of parts.

BOTS IN HORSES.

Give carbon disulphide in capsules; 2 drams at hourly intervals for three doses, followed in 24 hours by a pint of linseed oil. Laxative diet of green fodder. Destroy larvæ in feces in spring, then give bitters, iron and arsenic for a fortnight.

BROKEN KNEES. Horses.

For mere abrasion of skin, tie head up, to prevent the animal from lying down for 2 or 3 days, and apply white lotion on a compress continuously. When the skin is cut, shave or clip hair from surrounding skin, but use no water. Wipe away dirt with sterile gauze or remove by means of forceps and scissors. Paint wound and skin area with pure tinc. iodine and use sterile silk sutures, dry, aseptic gauze and bandage. Apply splint to leg, and tie the head up. If the wound suppurates, remove stitches, apply wet dressing (2 per cent. lysol), covered with oil silk or rubber, for few days, and then Peruvian balsam, aseptic dressing and bandage. If the sheath of extensor tendon is opened and tendon exposed, or joint opened, place the animal in slings (with splints on leg) and treat with tincture of iodine and wet dressings (if suppuration occurs) as above exactly as for the lesser injuries. Treatment is unavailing if the tendon

is much lacerated, the bones of the knee fractured or joint opened—except in the case of invasion of the carpo-metacarpal articulation alone.

Broken Wind, or Heaves in Horses.

Avoid water before hard or fast work; give water in moderation between meals; give mashes of bran and oats with carron oil; also small amount of moistened hay. Arsenic for long periods; iron and nux vomica in anemia and anorexia. If heart at fault, give tinc. of digitalis and strophanthus, 2 drams each, thrice daily. If bronchitis is a cause, see treatment under that disease. If there is true asthma, give spirit of chloroform, ʒ i; in ʒ ii of whiskey, and remedies advised for asthma in dogs.

Bronchitis, Acute and Chronic.

In acute in horses, to shorten attack give full dose of Dover's powder; also apply hot blanket and rubber sheet and dry blanket to chest, frequently changed; rub mustard paste on legs and bandage. Give bran mash, roots or grass and pint of linseed oil or enema; furnish a well-ventilated box stall. If there is fever, aconite; spirit of nitrous ether; and potassium citrate; mixed in a drench, thrice daily. Employ inhalations of sodium bicarbonate (ʒ ss to Oi) to increase secretion; later, inhalations of oil of turpentine (ʒ ss to Oi) to lessen secretion. In dogs with dyspnea give tablespoonful of syrup of ipecac to produce emesis; also, to increase secretion, ipecac; with syrup of squill; or ammonium chloride or carbonate; in chloroform water. With excessive secretion, prescribe internally oil of turpentine; or terpin hydrate or terebin; or belladonna; with tincture of nux vomica. If cough is constant and wearing, administer chloral hydrate; or codeine; or heroin; or paregoric. In the horse, instead of expectorants, use mustard, or stimulating liniments and Priessnitz poultice, to chest and throat, and inhalations; if cough is persistent, potassium iodide.

Chronic Form.

Treat as regards diet, fresh air, external applications and inhalations as in acute form. In dry cough, inhalations of sodium bicarbonate; with much secretion, use turpentine by inhalation. To increase secretion, administer internally sodium iodide, ammonium chloride; and carbonate. To lessen secretion, oil of turpentine; or creosote. When there is heart weakness, digitalis or strychnine. In young or debilitated, fat in some form, as cream, olive oil; or cod liver oil; housing must be dry, warm, and well-ventilated. Other remedies include the following:—Nitrites, strophanthus, quinine, arsenic, linseed tea, tar, benzoin, Eucalyptol, resin, balsam of Peru, balsam of tolu, myrrh, asafetida, ammoniacum, buchu, compound spirit of juniper, camphor, sulphur, sulphurous anhydride, alum, tannic acid, eserine, cantharides.

Bronchitis, Verminous. See *Hoose*.

Bronchocele, Thyroid Enlargement in Dogs. Goitre.

Paint tumor repeatedly with tincture of iodine; give 1-3 grs. dessicated thyroid gland, or potassium iodide internally twice daily. Or inject into gland 10 or 15 drops of iodine tincture at intervals of three days for 10-20 injections, although there is some danger of hemorrhage or embolism.

Insert hollow needle, before attaching syringe, to avoid entering a blood vessel. Surgery, partial resection or enucleation prove most successful, but goitre usually disappears in puppies with drug treatment.

BRUISES.

At the onset use:—Priessnitz poultice; hot fomentations; or antiphlogistine or refrigerants; or astringents, as compresses, wet with white lotion, and bandaging. Or alcohol; or arnica; or hamamelis, may be used. Anodynes, as laudanum, are indicated. To aid resolution, massage with stimulating liniments; with camphor liniment; with soap liniment; with ichthyol; with olive oil.

BURNS.

In burns of 1st degree:—Carron oil; or flour, starch, saleratus; dusted over burn. In burns of 2nd degree:—Soak sterile gauze in 1 per cent solution of picric acid, cover with absorbent cotton and bandage; reapply in 3 days and 2nd dressing may remain a week; also boric acid in 10 per cent ointment (vaseline) is harmless and efficient. In 3rd degree:—Wet dressings of saturated boric acid solution, covered with oil silk, or equal parts of Peruvian balsam and castor oil; remove dead tissue and treat as ordinary wound. In shock, stimulate with alcohol, strychnine and opium. Other agents of service include:—Tinc. iodine, orthoform, aristol, boroglyceride, carbolic acid, iodoform, salicylic acid, chalk, menthol, oil of turpentine, chlorinated lime, chlorinated soda.

BURSITIS (inflammation of the bursæ of the knee, elbow, hock, stifle, fetlock, cannon bone, withers and poll.

In acute cases—Cold compresses and pressure by use of flannel bandages; cold irrigations, or ice poultices; compresses wet with white lotion.

In chronic conditions (Hygroma).—Aspiration and injection of iodine or carbolic acid; excision, also blisters, red mercuric iodide or cantharides. See *Capped Elbow, Hock, Knee.*

CALCULI, BILIARY. See *Gall Stones.*

CALCULI, INTESTINAL. See *Colic.*

Removal by high enemata, by hand in rectum or abdominal section. Pain relieved by morphine and atropine under the skin. Obstruction by sand may be overcome by physic ball.

CALCULI, RENAL AND VESICAL.

No medical treatment will dissolve or remove stone from the urinary tract although such may naturally escape. The medical treatment is therefore wholly prophylactic.

In Cattle and Sheep—Give sodium bicarbonate on the food, and allow an abundance of water; feeding sheep should be compelled to move thrice daily 100 yards to cause them to urinate. Ammonium and sodium benzoate, in the horse, or hydrochloric or sulphuric acid.

In Dogs, lithium salts may be placed in the drinking water, or lycetol (dose, gr. 15). These agents may prevent calculus formation but no drug will dissolve calculi in the body.

In Oxen—Work forward urethral stone by massage or do ischial urethrotomy.

In Sheep—Stroke the urethra to remove stone or sediment about meatus. Success is only secured by amputation of the appendix in many cases; lithotomy, lithotrity, or urethrotomy are often required. To relieve pain and spasm in urinary calculus, give hot enemata, and morphine, and atropine, under the skin.

CANKER OF EAR. See *Otorrhea.*

CANKER OF FEET IN HORSES.

Throw the animal and remove by actual cautery or knife all the diseased horn of the sole and frog down to the sensitive tissue. Tight bandage above fetlock to prevent hemorrhage after animal up. Dress foot with one of following:—Salicylic acid; stick silver nitrate; formaldehyde (10 per cent); equal parts of alum, or tannic acid, and iodoform; creolin or iodine ointment (5 per cent.); equal parts of zinc, copper and iron sulphates, vaseline to make paste, and enough creolin to equal 5 per cent. Then cover with tow, false sole of leather or iron, and shoe. Dress daily with one of above agents and remove any specks of canker, if present. When horn forms, dress with tar or calomel. After first days of treatment animal may do best at work.

CAPPED ELBOW, HOCK, KNEE.

Treatment as for bursitis (see *Bursitis*) in acute stage; in bursitis (of perforatus) or capped hock, apply high-heeled shoe; in capped elbow, prevent increase of trouble by use of heel or ring pad; when large amount of induration has formed it must be excised.

CATARRH. See *Coryza, Rhinitis, Acute.*

CATARRH, CHRONIC.

Symptomatic of chronic rhinitis, disease of accessory sinus, and guttural pouches, glanders, carious teeth and new growth. Isolate and test for glanders. In general give tonics as iron and arsenic, graze or feed from floor, rest from work and fresh air. Inhalations of phenol or co. tinc. benzoin. Treatment mainly surgical—trephining, drainage and irrigation of maxillary sinus; hyovertebrotomy in disease of the guttural pouches. In sheep, see *Oestrus Larvæ.*

CATARRHAL FEVER. See *Malignant Catarrhal Fever of Cattle.*

CEREBRAL ANEMIA.

Shown by fainting (syncope). See *Syncope.*

CEREBRAL HEMORRHAGE. See *Apoplexy, Cerebral.*

CEREBRAL HYPEREMIA.

Raise head, ice bag to poll; venesection, 4-8 quarts in horse; veratrum. Mustard paste to legs and bandage. Warm covering; croton oil; dark, quiet quarters; if swallowing possible, gruels and mashes.

CEREBRITIS. See *Encephalitis.*

CEREBRO-SPINAL MENINGITIS.

Chiefly enzoötic and epizoötic in horses and sheep. See also *Encephalitis* for general treatment. Quiet, dark, cool quarters; slings for horses if animal cannot stand. Physic ball with calomel for horse, or barium chloride intravenously if the horse cannot swallow; ice to head, ergot, atropine, strychnine, cantharides; catheterize; avoid moldy food and stagnant water; secure food from other regions; dry stable; disinfect quarters after occupancy.

CHOKING. See *Oesophagus.*

In Cattle: fasten wooden gag in mouth to cause salivation, swallowing and eructation, or give olive oil by the mouth and try to push foreign body upward in gullet with one hand externally, while the other is in the mouth. This failing, pass probang or do esophagotomy. Severe tympanites demands massage of left flank or passage of stomach tube; if this ineffective, puncture most prominent point in left flank between last rib and angle of the haunch.

In Horses first try apomorphine, if foreign body may not be removed by the hand in the pharynx, pass probang. In dogs and pigs apomorphine subcut., or use expanding probang.

CHOLERA. See *Fowl Cholera* and *Hog Cholera.*

CHOREA.

Occurs in dogs often after distemper or from indigestion or irritation of worms. In distemper, an outdoor life in the country, and diet with much fat and proteids—as bread or oatmeal with cream, strong broths, and meat once daily—are indicated; iron is also advisable, as Blaud's pills, each gr.v. thrice daily; arsenic, as Fowler's solution, may be prescribed in increasing doses until ♏xxx are given daily. If movements severe, give dogs chloral, gr. v, and sodium bromide, gr. xx-xxx, thrice daily (with laudanum, ♏ v, if necessary). For the horse, chloral and sodium bromide, each ʒ ss, with fluidextract belladonna, ʒ i, twice daily. If due to worms or indigestion, treat these troubles; if arthritis precedes chorea, give sodium salicylate. The Priessnitz poultice may afford relief. Other remedies include:—Antipyretics, hyoscyamus, cannabis, anæsthetics, eserine, gelsemium, conium, valerian, zinc valerianate, camphor, strychnine, quinine, asafetida.

COCCIDIOSIS.

Affects liver and intestine of cattle, sheep, pigs, dogs, rabbits, fowl, etc. Due to cyst-like parasites (Coccidia) which invade the mucous membrane and biliary tubes. Prevent by cleanliness of premises, removal of feces, disinfection. One form of white diarrhea of chicks (C. cuniculi), and prevented by giving sterile water and food and keeping the brooder aseptic. Curative treatment unsatisfactory, give physic of oil, and disinfectants by mouth, glycerin and ferrous sulphate, sodium thiosulphate, creolin, sulphur.

COENUROSIS. STURDY. GID. TURN-SICK IN SHEEP.

Prevention: Brains of sheep and cattle must never be fed to dogs; twice annually sheep dogs must be starved and given areca nut, with male

fern, followed by a cathartic, and feces burned. Repeat this in two days. Sheep's brains, when infested, must be burned or boiled; young sheep must not be pastured in infested regions. Treatment by trephining cysts, when they can be localized in the brain by soft spots on skull, and only in those which definitely circle about. On the range; open skull of dead affected sheep with axe, mash brain and cover it with 2 ounces turpentine, formalin, or sheep dip to kill embryos and keep dogs from eating brain. Meat good for market in early stage or for dogs, pelts may be sold.

Cold, Exposure to.

Applications of hot blankets and mustard paste; alcohol.

Colic in the Horse.

Place in box stall with plenty of bedding; in mild spasmodic colic, walking exercise, but in no other cases; morphine and atropine, under the skin. In mild cases of spasmodic colic, ether and aromatic spirit of ammonia (each, ℥ ii) with spirit of chloroform, ℥ i, may be given; or chloral, ʒ i in one pint of linseed oil. Hot turpentine stupes, useful in all kinds of colic. In flatulent colic, oil of turpentine, ℥ ss; carbolic acid, ♏x; ether and spirit of chloroform (each ℥ i), may be prescribed together in a pint of linseed oil. A purge is indicated at the earliest moment—an aloes ball, or linseed oil, and hot enemata, in spasmodic colic; in flatulent colic, give arecoline, or barium chloride, ʒ i, by mouth, or gr. xv intravenously, and enema; also puncture with trocar between last rib and angle of ilium on right, or left side (when most distension here), if tympanites is increasing. In colic from overloading the stomach, use the stomach tube; also barium chloride. With impaction of colon, alternate linseed oil and Glauber's salts and give strychnine with atropine on tongue thrice daily; empty rectum by hand and use enemata as above; if all fails, try arecoline, physostigmine, or barium chloride. Colic due to enteroliths and volvulus cured by surgery. In twist of colon eserine or arecoline often relieves. Colic from invagination may be treated by elevation of hind quarters, enemata in enormous quantity, or laparotomy. Physostigmine may relieve but purgatives generally aggravate intussusception. Colic from new growth or stricture of gut can be alleviated by manual removal of feces twice daily and by enemata. Worm colic is cured by remedies found under *Worms*. Recurrent colic of influenza is treated with salicylates thrice daily and a physic ball (aloes ʒ iv with gr. xx of calomel), and pain is relieved as in mild spasmodic colic.

Coma.

Apply ice to head; use cold douche or alternate hot and cold douches; mustard paste and bandaging to legs; venesection, purgatives, aloes, eserine, arecoline, or barium, croton oil, stimulants, if collapsed—ether or ammonia, or strychnine. In diabetic coma, sodium bicarbonate, see *Diabetes Mellitus*.

Congestion of Lungs. See *Pulmonary Congestion*.

CONJUNCTIVITIS.

In mild form, drop in eye boric acid (2 per cent.) solution, or zinc sulphate (gr. i-ʒ i); also alum or cupric sulphate, or silver nitrate may be used. In muco-purulent and purulent forms, wash frequently in boric acid solution (2 per cent.), and drop in the eye argyrol, in 10 per cent. solution thrice daily after boric acid irrigation; in addition, shade both eyes and make constant applications of ice water in severe cases. In muco-purulent cases, silver nitrate (gr. ii-ʒ i) may be painted on everted lid (instead of argyrol) once daily, in addition to frequent boric acid irrigations. Other remedies include: cocaine, protargol, mercuric oxides, citrine ointment, creolin, lysol, corrosive sublimate, scarification. Apply hydrargyri oxidum flavum in vaseline (gr. i-ʒ i) at night to lids, to prevent them from adhering.

CONSTIPATION.

Diet, exercise.

Dogs.—Two or three compound cathartic pills or castor oil. Injections of ʒ ii sweet oil followed by warm water, combined with massage of belly and removal of feces by finger or blunt curette from rectum, in obstinate constipation. Until constipation relieved, give nothing but broth and lean cooked meat with salt. In chronic constipation give some cooked liver and dog biscuit, with mixed diet, and Sharp and Dohme's aromatic fluidextract cascara sagrada, ʒ ss, once or more daily, pill laxativæ comp., or phenolphthalein; calomel occasionally.

Horses:—Aloes, linseed oil, calomel, Epsom salts, arecoline, eserine, barium chloride, enemata.

Cattle:—Epsom salts, calomel, linseed oil, croton oil, gamboge.

Foals and Calves:—Carron oil, Gregory's powder.

Puppies:—Suppositories, soap or glycerine; small doses of castor oil (ʒ i-iv) phenolphthalein, or calomel (gr. i).

Birds:—Fowl, calomel, gr. i on food; castor oil, ʒ i; cold enemata, tinc. rhei, rhubarb (gr. iii-vii), or senna (gr. xv-xx), in pill. Small birds, empty rectum with bulb-tipped probe and oil. Give artificial Carlsbad salts in drinking water (gr. iiss to ʒ i).

Other agents include the following: Buckthorn, jalap, colocynth, elaterin, podophyllin, arecoline, ox gall, pilocarpine, veratrine, strychnine, glycerin, belladonna, hyoscyamus, sulphur, myrrh, asafetida.

CONVALESCENCE.

Diet, fresh air, exercise; hydrochloric acid, pepsin, bitters, strychnine, gentian, quinine, calumba, quassia, hydrastin, iron, cod liver oil.

CONVULSIONS, ECLAMPSIA, EPILEPSY.

Remove cause when possible by use of cathartics or emetics in indigestion and overloaded stomach; by incising gums in teething; by anthelmintics in worms. In attack, owner may immerse puppy in warm bath; the veterinarian should give chloroform inhalation, and afterwards administer fluidextract ipecac, ♏30, and enema. To prevent further attacks in dogs or horses, administer chloral with sodium bromide, thrice daily in water. When fits are recurrent, epilepsy is to be suspected. In this case, give

sodium bromide thrice daily for considerable time; and tinc. belladonnæ or chloral, if bromides ineffectual. Or acetanilid with monobromated camphor may be prescribed in capsules thrice daily for dogs. In puerperal eclampsia of bitches, inject morphine (gr. ss-i) under the skin, or employ chloroform inhalation, and an enema of chloral in boiled starch solution.

Corneal Opacities.

When recent, apply yellow oxide of mercury ointment to upper lid once daily (gr. i-ii to 3 i), or calomel. After a year, opacity becomes permanent; do iridectomy under clear area in cornea.

Corneal Ulcer.

Yellow oxide of mercury, as for opacities; calomel, as for opacities; or touch ulcer with silver nitrate solution (2-4 per cent.) by means of pointed camel's hair brush; atropine during treatment. Instil 2 per cent. solution of fluorescein to stain and locate ulcer. In suppurating keratitis, touch yellow infiltrated area of ulcer with point of knitting needle heated cherry red, after using cocaine.

Corns in Foot of Horse.

Remove shoe and cut away discolored area to remove pressure or exudation under sole; disinfect with pure phenol or tincture of iodine; flaxseed poultices if much lameness; bar or wide-web shoe with rubber or leather.

Coryza, in Horses.

Fresh air, outdoors in suitable weather; moderate covering, legs bandaged and mustard paste rubbed on them in stable. Diet:—roots, bran mashes with few ounces of linseed oil. Fluidextract belladonna (3 ss every 2 hours, first day or two). Inhalations, co. tinc. benzoin. Other remedies are:—Spirit of nitrous ether, aconite, Dover's powder, opium, cocaine, adrenalin, menthol, quinine, arsenic, bismuth.

Cough.

Well-ventilated quarters, warm clothing; inhalations, turpentine stupes, mustard to throat and chest, Priessnitz poultice. From catarrh in upper air-passages, see *Coryza, Pharnygitis, Laryngitis.* Bronchial Cough. See *Bronchitis.*

Dry Cough—Ammonium chloride and carbonate, ipecac, Dover's powder, sodium bicarbonate or potassium citrate. With excessive secretion—oil of turpentine; terpin hydrate or terebin, tar, belladonna, balsam of tolu, creosote, internally or by inhalation.

Constant, Harassing or Reflex Cough—Opium, heroin, chloral, chloroform, phenacetin, bromides, belladonna, wild cherry, prussic acid, cannabis indica, gelsemium, camphor.

Verminous Cough. See *Hoose.*

Cough, Chronic, of Horses. See *Bronchitis, Chronic* and *Broken Wind. Laryngitis.*

Cracks or Fissures. See *Fissures.*

Cramps.

Atropine, belladonna.

Crib Biting. See *Wind-Sucking.*

CROUP, OR ROUP. PSEUDO-MEMBRANOUS CROUP. "DIPHTHERIA."

True diphtheria is rarely seen in cats and dogs (Klebs-Lœffler bacillus).

Croup common in fowl. Isolate sick and newly-bought fowl. Infected premises disinfected and whitewashed. Dead fowl burned, utensils disinfected. Paint affected parts in throat with mixture of Dobell's solution and hydrogen dioxide with feather. Internally, give twice daily to fowl, potassium chlorate, gr. v, and tinc. of ferric chloride, ♏v, in a little glycerine and water. Diarrhea relieved by 10-15♏ of 2 per cent. tannin solution, for fowl. Open distended sinus's under eye. Wash eyes with boric solution (2 per cent.)

Croup in Calves, Lambs and Pigs. Isolate, disinfect premises. Tinc. ferric chloride and potassium chlorate, of each one-half dram thrice daily in glycerin and water. Cleanse nose with normal salt solution, and throat with saturated boric acid solution with syringe and swab. Whiskey and milk and eggs; green food and Carlsbad salts.

CURB.

Fomentations, cold irrigation, Priessnitz poultices, cantharidal blistering and actual cautery. Rest and high-heeled shoe.

COW POX. See *Variola.*

CYSTITIS, ACUTE AND CHRONIC.

Diet:—Large animals, barley water and mashes; small animals, milk. Rest important.

In acute form, ice water or hot enemata. Purge with salts or linseed oil, large patients; with castor oil in dogs; morphine and extract of belladonna in suppository to dogs (each gr. $\frac{1}{8}$-$\frac{1}{4}$). Large animals, spirit of nitrous ether, laudanum (each ʒi), may be given together every 4 hours, sodium bicarbonate, potassium citrate or acetate. When acute symptoms pass, prescribe one of the following: hexamethylenamine, sodium benzoate with boric acid. If urine is alkaline, use acid; when cystitis is persistent employ colon, or mixed vaccine containing the B. coli communis.

In chronic form, buchu; but bladder irrigation then most valuable—silver nitrate (1-1,000), boric acid or borax (1-2 per cent), creolin (1-200).

Other remedies are:—Hyoscyamus, oil of juniper, acacia, cantharides, lysol, balsam of tolu and Peru, salol, turpentine, eucalyptol, thymol, myrrh.

DEBILITY.

Nourishing diet—milk, eggs, linseed and cotton seed meal. Small animals—bovinine, broths, beef juice, cream; olive oil, cod liver oil, alcohol and bitters in convalescence, as quinine, strychnine, gentian, calumba, iron and arsenic in anemia.

To stimulate appetite and digestion, with bitters in large animals: ginger, cardamon and coriander, fennel and funugreek.

In the young and in nervous debility: calcium phosphate, glycerophosphates and phosphorus.

DECUBITUS. BED SORES.

Change position often or use slings; sufficient bedding and cleanliness.

Alcohol with tannic acid (5 per cent.) to harden skin. Aristol, chlorinated lime.

Delirium.

In acute inflammations and injuries of head, ice to poll, venesection, purges, as for Cerebritis. With exhaustive diseases—alcohol, strychnine. Sedatives, if severe, as morphine; chloral, bromides.

Dentition Fever.

In horses give soft, laxative food of mashes, green fodder with carron oil. Lance gums, if swollen, and extract milk teeth where interfere with eruption of permanent teeth.

In dogs, when dentition delayed, give syr. of calcium lactophosphate.

Depraved Appetite. Pica. Licking Habit.

Cattle—Remove primary digestive disorder; generous feeding with plenty of salt; outdoor existence. Apomorphine, gr. ii hypodermatically, once a week for 3 injections.

Calves and Lambs—Calves segregated; lambs isolated when not sucking; apomorphine (gr. $\frac{3}{4}$) subcutaneously.

Foals—Keep in stable, give salt by mouth and apomorphine (gr. $\frac{1}{2}$-$\frac{3}{4}$) subcutaneously once or twice weekly.

Diabetes Insipidus. Horses.

Commonly due to musty or moldy fodder, or symptomatic of other diseases. Change diet, or steam, boil or kiln-dry moldy food; give physic ball; place sodium bicarbonate in drinking water to relieve thirst, 4 ʒ daily. Lugol's solution or potassium iodide, most successful remedies. Contract renal vessels with ergot. Tonics: iron, nux vomica, arsenic. Restrict water to slight degree.

Diabetes Mellitus.

In dogs, restrict diet to cooked meat and fat and broths; avoid liver. Sodium bicarbonate in enormous doses to prevent coma, codeine, opium, Fowler's solution, urotropin.

Diaphragm, Spasm of. Hiccough. Thumps.

Horses, compound spirit of ether; chloral, spirit of chloroform. Give purge and use lavage; morphine subcutaneously, with atropine; inhalation of amyl nitrite or chloroform. Fomentations over diaphragm, traction on tongue. Enema, laudanum (ʒ iv) with sodium bromide (ʒ i), in pint of boiled starch solution.

Dogs:—Emetic: Ipecac.

Diarrhea.

Laxatives to remove source of irritation in all cases at the onset.

Horses:—Linseed oil, castor oil or calomel.

Cattle:—Magnesium sulphate, calomel, castor oil.

Foals and calves:—Castor oil, ʒ ss; gray powder or rhubarb.

Special diet and restriction of water. Rest and warm covering. Opium most useful after purge, with one of the following astringents: bismuth, chalk, catechu, kino, tannic acid, aluminum hydroxide, lead acetate, mineral

acids. Antiseptics, especially with flatulence and foul discharges; carbolic acid, creolin, salol, naphthalene, boric acid.

In Fowl:—Dry, warm housing. Boiled rice and boiled milk. Laudanum, ℥i-v.

White diarrhea (White Scours) of calves. From absorption of colon bacilli from dirty teats or through infected navel. Also occasionally due to B. necrophorous which may cause omphalophlebitis and arthritis and necrosis of navel. Prevention. Give colostrum and then pasteurized milk in sterile pail. Sterilize the mother's perineum and udder before and after birth; disinfect navel with tincture of iodine; isolate sick. Disinfect the dead and stable. Give colon vaccine or horse serum from animal immunized to polyvalent colon bacilli, as preventive. White diarrhea of new-born chicks—1. Due to B. pullorum in ovaries and eggs of infected hens. Resemble typhoid bacilli. Disease communicated from hen to egg and from infected chicks during first four days of life. Use eggs from uninfected farms for 1 year. Keep new-born in dark place so will not pick up droppings for first four days.

Keep absorptive litter on floor of brooder and food and water in uncontaminated vessels. Feeding sour milk useful. Only strongest birds at 8 to 10 weeks selected for breeding. 2. White diarrhea of chicks due to Coccidium avium. Oocysts in droppings and live in soil 1 year. Outside of egg infected. Sterilize eggs in alcohol and use incubators for hatching. Remove newly fledged chicks to new premises. Kill infected birds. Surface soil removed 3 inches down and burned, disinfect the houses, roosts, premises and utensils.

See also *Enteritis* and *Dysentery*. Arsenic in chronic cases.

Diphtheria.

Diphtheria, due to Klebs-Loeffler bacillus in man, is occasionally seen in cats and dogs. They should be killed to prevent spread of the disease to man.

See *Croup*, Pseudo-Membranous.

Disinfection or Sterilization of Skin. See *Wounds*.

Of vagina, swab out with green soap and warm water and sterile gauze and 2 per cent. lysol solution, or swab with ½ strength tincture of iodine without washing.

Of uterus, irrigate with 2 per cent. lysol solution.

Of horses' feet. Remove shoe, trim horn and paint with tincture of iodine.

Of eye, irrigate with 2 per cent. boric acid solution. Tears act as normal salt solution and prevent sepsis.

Dislocations. Luxations.

Reduce by aid of anesthetics. After reduction, fix joint by plaster of Paris splint for 10 days, and rest (in slings, if necessary). When splint not possible, apply fly blister to secure rest of joint.

Distemper in Dogs and Cats.

A vaccine prepared from B. bronchisepticus by Parke, Davis & Co. is the surest mode of prophylaxis if given a month before exposure.

Treatment of the disease is most successful with a vaccine composed of the former, combined with staphylococci and streptococci, and is said to cure over 80 per cent. of cases.

Keep the patient constantly clean with 2 per cent. lysol baths. The kennels must be frequently washed with same and feces constantly removed to avoid secondary staphylococcic infection which is generally the cause of death.

Give gr. ii. calomel night and morning at onset, till free catharsis produced. For conjunctivitis, boric acid gr. x; and zinc sulphate, gr. 1; in ʒ i. water. If severe, 5 per cent. argyrol solution. If opacity or ulcer or cornea, see *Corneal Opacities* and *Ulcers* for treatment.

Cough:—Wet flannel bandage and oil silk about neck; also syrup ipecac (♏v-xv), in syrup squill (ʒ i), with codeine (gr. ⅛-½), if necessary.

Anorexia overcome by tinc. nucis vomicæ (♏v-xx), with equal amount of H Cl in water after eating.

Vomiting and diarrhea treated with bismuth subnitrate (gr. x-xxx) with tannigen (gr. v-x) and laudanum (♏v-x).

In delirium, use chloral (gr. v-xv) with bromides (gr. xx-xxx), by mouth or rectum.

With weakness and paralyses, syrup of the phosphates of iron, quinine and strychnine (ʒ ss-ii); strychnine.

In anemia, reduced iron in pills.

In eruption, use zinc oxide ointment.

Diet:—Milk, scraped beef, bovinine, beef juice, strong broths, brandy with milk and white of egg. Boiled milk in diarrhea.

Patients isolated, and when recovered the premises must be cleaned and disinfected. Country air favors recovery.

DOURINE. See *Maladie du Coit.*

DROPSY, CARDIAC, RENAL, HEPATIC. ASCITES.

Increase function of heart, kidneys and liver by stimulants to these organs, and use purges and diaphoretics. Digitalis, and with squill are often combined with spirit of nitrous ether and potassium citrate or acetate. Restrict fluids; give horse physic ball; cattle: magnesium sulphate in concentrated solution; dogs: comp. jalap powder (ʒ ss) in capsules three times daily; potassium iodide to absorb exudate.

In Ascites, aspirate dogs just behind navel and bandage belly; cattle: aspirate belly midway between navel and stifle, right side.

Diet.

Other remedies are: Caffeine, strophanthus, oil of juniper, pilocarpine, calomel, colocynth, elaterin, sugar of milk.

Withhold salt from the food when there is nephritis.

See also *Hydrothorax.*

DYSENTERY.

Common in new-born, especially calves, in which it is usually fatal. Prevent by antiseptic treatment of aborting and parturient cows; by isolation of patients and disinfection of their discharges; by segregation of cows about to calve. Treatment of little value in calves. In other ani-

mals, give purge, calomel, or magnesium sulphate, or castor oil. Ipecac is a specific, especially Dover's powder. Irrigations of rectum with creolin, or lysol, or silver nitrate. Internally, opium with astringents, as: lead acetate, white oak, catechu, kino, tannic acid, hematoxylon. Rest; external warmth; and diet. Antiseptics: naphtalin, turpentine. Arsenic.

Dysentery, Chronic Bacterial, of Cattle. Johne's Disease.

Treatment is chiefly prophylactic. Isolate and destroy diseased animals. Feces burned or buried deeply. Scrub and scrape fecal contamination from barns and apply quicklime to floors and 3 per cent. formalin to walls and whitewash containing the same. Internally, salol, bismuth subnitrate, turpentine, etc., have little but temporary effect, as the disease is fatal.

Dyspepsia. See *Indigestion.*

Dyspnea. See *Laryngitis, Broken Wind, Croup, Asthma.*

Pulmonary and Heart Diseases: Nitroglycerin, nitrites, chloroform inhalation or morphine in asthma or angina pectoris.

In chest diseases, counter-irritation externally. Tracheotomy in mechanical obstruction. Treat causal disease.

Eclampsia. See *Convulsions.*

Ecthyma in Horses, Dogs and Sheep.

Deep-seated pustules leading to formation of dark crusts, communicated by contact with other animals, or by brushes, harness, or objects touching the lesions. Isolate patients and secure cleanliness and proper hygienic surroundings. Give tonics, bitters and good feeding. Remove crusts with soap and water. Apply to lesions, salve containing salicylic acid (gr. xv-℥i) in zinc ointment; or, when animal can not lick it off, hydrargyrum ammoniatum (gr. v-℥i) in zinc ointment. Ulcerations are treated with Peru balsam covered with zinc ointment. Disinfection of premises and utensils.

Eczema.

In Dogs—Avoid water except to remove crusts after soaking in sweet oil for 24 hours; in chronic cases, shampoo skin with green soap and water; clip hair; employ muzzle or bandaging to prevent biting and scratching and avoid external preparations which will poison if swallowed. In acute eczema, carron oil or calamine lotion. In moist stage, zinc oxide ointment after the application of black wash. In weeping patches, silver nitrate solution (2-6) per cent. after cleansing with hydrogen dioxide. If suppuration, astringent dusting powders: bismuth, starch, dermatol, glycerite of tannin. With much itching, zinc ointment with creolin (5 per cent.). In Chronic Eczema with scaly, thickened skin, tar ointment, oil of cade in olive oil (1-8), or with zinc ointment (1-8). Relieve constipation by cascara sagrada; give liver occasionally and dog biscuit. Avoid fleas, dirt, friction. In acute cases, bread, soup or milk and avoid oatmeal; starving in overfed animals, and 2-3, co. cathartic pills. Fowler's solution in chronic form.

In the Horse—In the scaly form (wrongly styled psoriasis), thorough grooming and destruction of parasites. Remove scales by soaking in olive

oil and washing. Apply oil of cade, liquid tar or creolin in alcohol (1-10). Pustular form on mane and tail, avoid constant wetting and common soap; clip hair; and apply hydrogen dioxide and 5 per cent. silver nitrate solution and dust with tannic acid and iodoform (1-3), or use tar ointment. In eczema of heels (grease), in acute stage apply zinc ointment, or white lotion, or pink ointment. In later stages, with moisture and scabs, cleanse and apply balsam of Peru, wool dressing and bandage, or tannic acid and iodoform (1-3). Exuberant granulations treated with lunar caustic or actual cautery.

In Cattle—Treatment similar to eczema in horse. With total loss of hair use liquid tar in alcohol (1-10). Other remedies include:—Ichthyol, sulphurated potash, sulphur, yellow wash, iodine, boric acid, chalk, lead acetate, zinc sulphate, white precipitate ointment, citrine ointment, carbolic acid, salicylic acid, oleate of mercury, blue ointment, thymol, chrysarobin, hamamelis, glycerite of starch, pilocarpine, phosphorus, cod liver oil.

Elephantiasis of Horses.

Chronic swelling or dermatitis with proliferation of dermal tissues and deformity of limbs following repeated lymphangitis.

Bad cases with skin in folds incurable. Laxative diet, iodine ointment, fibrolysin, potassium iodine internally, exercise. Tonics, see *Grease*.

Emphysema, Subcutaneous.

Air generally becomes absorbed without treatment. If external wound, try to prevent sepsis. If absorption delayed, strap with adhesive plaster, or make pressure by bandage. Incision and puncture undesirable as aid to sepsis.

Emphysema, Pulmonary.

Chief lesion in "Broken Wind." See *Broken Wind*.

Empyema Thoracis.

Incision into intercostal space, or better, excision of a portion of a rib for drainage, and great care in asepsis, under no (or partial) anesthesia, to facilitate expansion of lung through coughing. All adhesions to lung must be broken; bleeding is stopped by hot, normal salt solution from pitcher; drainage tube, self-retaining, of spool shape. Collargol. Irrigation of the chest not usually advisable unless discharge very fetid. In localized abscess, aspiration is sufficient sometimes.

Encephalitis. Cerebritis. Meningo Cerebritis.

Quiet, dark, cool quarters. Box stalls with slings for horses, if animal unable to stand. At onset, horse, aloes ball with calomel. Cattle—Glauber's salts with croton oil. With high fever and bounding pulse, venesection and aconite, or veratrum. In excitement and mania, morphine, chloral, bromides. Collargol. Lumbar puncture behind 5th lumbar vertebra, to relieve pressure and for bacterial examination of cerebro-spinal fluid. In convalescence, overcome paralysis by ergot, given with potassium iodide.

Endocarditis.

Acute—Prevent in acute rheumatism by giving sodium bicarbonate, and blistering over heart; collargol. If pulse strong, give aconite, and fasten ice-bag

over heart in acute stage. Morphine, under skin to quiet dyspnea. Digitalis in irregular pulse, with nux vomica. Aconite only at onset; later, whiskey, quinine and strychnine. Nourishing, concentrated diet, absolute rest.

Chronic Form. See *Heart Disease.*

ENTERITIS.

In Horse—No solid food allowed, warm water in moderation. At onset only: castor oil, laudanum and belladonna, or calomel with powdered opium in ball. To quiet peristalsis: opium or morphine every few hours. With high fever and strong pulse: venesection, aconite or veratrum. Turpentine stupes. Stimulants: alcohol and strychnine, in case of threatened collapse. In convalescence: cooked gruels, followed by scalded oats and a little green food.

In Dogs—Avoid food or drink in vomiting. Calomel, followed by opium and bismuth subnitrate. In convalescence: meat juice, broths, lime water and milk.

In Cattle—Glauber's salts at onset. Externally, turpentine stupes. Laudanum with chalk to stop diarrhea. With bloody diarrhea: laudanum with tannic acid; also ergotin under the skin. Strychnine and alcohol. Diet: boiled milk, raw eggs, flour gruel with sodium bicarbonate, cooked roots.

In Calves—In those not suckling, replace milk by whey, made by adding rennet to warm milk and straining. Also by broths, rice or barley water or thin flour gruel. When milk is again given, it should be scalded and diluted with an equal part of water. Give at onset castor oil (℥ i). Sucklings fed every three hours, so as not to gorge.

Cows giving milk containing over 4½ per cent. fat may be unfit mothers. After castor oil, give bismuth subnitrate (gr. xxx.) three times daily. Brandy for debility, and paregoric (℥ ii.) if much pain and diarrhea.

ENTROPIUM.

If only inturned eyelashes, they may be pulled out at intervals. The application of a finely pointed stick of caustic potash in a line parallel and near to ciliary border of under lid on the skin—once or more—may cause lid to regain its normal shape. Otherwise remove elliptical piece of skin from eyelid and suture. At same time split margin of lid lengthwise, leaving all eyelashes on outer flap, and lengthen palpebral fissure at outer canthus by cutting with scissors.

EPILEPSY. See *Convulsions.*

EPISTAXIS. NOSE BLEED.

Inject adrenalin with syringe (1-5,000). Pack nostril with gauze soaked in same. Vinegar and water (1-2). Insufflation of powdered alum or tannic acid. Internally, ergot, hamamelis or turpentine. In purpura inject fresh horse serum; ergot, calcium chloride, gelatin. Raise head and place ice-bag on forehead. Examine for polypus, or causative general disease of brain, heart, lungs.

ERYSIPELAS.

In Horses on head, enzoötic. In Sheep, attacks head. Swine, as Mal Rouge or Swine Erysipelas. See *Hog Cholera.*

Antistreptococcus serum, or vaccine, in horse. Generous diet with alcohol, milk and eggs. Isolate patient and after recovery disinfect premises. Well-ventilated quarters. Antiseptic treatment of any wound present. Injections of carbolic acid or painting affected area with pure phenol followed by alcohol. Cold compresses of saturated boric acid solution. Heavy coat of collodion about lesion to limit spread, first shaving hair. If pus forms, it must be liberated by incisions; otherwise avoid the use of knife. Quinine and tinc. ferric chloride.

ERYTHEMA.

In Horses, "Mud Fever," or "Scratches."

Leave hair long on pasterns; do not wash legs after driving but wait until dry and brush off dirt. Pink ointment, white lotion, calamine lotion, zinc oxide and starch, lead acetate, boric acid, camphor, vaseline, hamamelis, tar. When erythema results in a dermatitis, as in Cracked Heels of horses, stimulate with stick silver nitrate, or Peruvian balsam, and use astringents, as pink ointment and white lotion. In general erythema, give purge and light diet.

EXOSTOSES.

In early stages treat as for *Periostitis*, which see. For later outgrowth of bone, iodine or cantharides. Red mercuric iodide, point firing; rest.

FAINTING. See *Syncope*.

FALSE QUARTER.

Blister coronet; cantharis. Treat wound in coronary band which causes defect in wall of hoof. Apply bar shoe. Cut dead horn away. Keep dirt out of fissure by filling it with gutta percha and ammoniacum.

FARCY. See *Glanders*.

FAVUS, in Cats, Dogs, Horses, Cattle, Fowl.

Remove crusts by soaking in sweet oil and washing in green soap and water. Sulphur ointment, or 5-10 per cent. ointments of the following: Naphthol, resorcin, thymol, tar, or creolin and salicylic acid. Sulphur and salicylic acid least toxic. Or apply tinc. of iodine and goose grease (1-8).

FEVER.

Cold air and moderate covering, and bandaging of limbs (horses). Cold applications. Cold drinks, cold enemata. Spirit of nitrous ether with aconite and potassium citrate, especially in catarrhal conditions. With intestinal autointoxication, calomel, magnesium sulphate, castor oil.

In hyperpyrexia, phenacetin, acetanilid, antipyrin. Diet. In most infections, as influenza, septicemia, pneumonia, and in continued low fevers: quinine, alcohol, strychnine.

In convalescence, see *Convalescence*.

FISSURE.

Of Anus—Expose with speculum and touch with pure phenol on a small swab. Iodoform in carbolized vaseline (1-8), applied daily after enema. Keep bowels loose with salts or oil. Orthoform, belladonna.

Of Teats—Udder and teats thoroughly washed with soap and water and

saturated boric acid solution. Milk removed with boiled milking tube. Touch fissure with solid silver nitrate, and coat with co. tinc. of benzoin frequently, and keep covered with boric acid in vaseline (10 per cent.). Also Peru balsam or tannin.

FISTULA.

The following ointment has proved of surprising value. The ointment is softened by heat and injected with a sterile syringe of glass or metal, through the nozzle alone, or through a sterile rubber tube—until the fistula is filled. Every third day enough more is injected to replace that which has escaped. ℞. Bismuth subnitrate, 6 parts; white wax and soft paraffin, each 1 part; vaseline, 12 parts. Boil and mix and place in a sterile jar. Substitute chalk for bismuth to avoid poisoning when several ounces are required.

Or inject daily with hydrogen dioxide (8 oz.) containing 2 m. of formalin, if free opening. To secure healing, inject daily—after above—carbolic acid in glycerine, or tinc. of iodine; or 3 per cent. silver nitrate solution. Curette and open up sinuses. If milder measures fail, use arsenic or corrosive sublimate. If fistula refuses to heal, suspect foreign body or dead bone or tendon in wound. In fistulous withers and poll evil the use of a mixed vaccine has been very successful.

FLATULENCE. See *Tympanites, Colic, Indigestion.*

FLEAS. Pulex irritans var. Canis et Felis.

In Dog and Cat—Frequent grooming and 2 per cent. creolin or lysol baths, followed by clean water and drying. Clean bedding of sawdust or shavings, frequently changed. Application of pyrethrum to dampen hair, but not in puppies and kittens. Carbolic soap. Oil of anise.

FLY-BLOW IN SHEEP.

Dress wounds with tar, and 2 per cent. solutions of lysol or creolin.

FOOT-AND-MOUTH DISEASE. EPIZOOTIC ECZEMA.

In Cattle, Sheep, Swine and Goats.—The only rational treatment is prophylactic. Strict quarantine of infected premises and animals, and kill all exposed and diseased animals as soon as possible. After diseased animals removed, disinfect premises. Healthy animals not put in disinfected premises for month. Burn or bury dead carcasses and infected manure. Older treatment follows: Diet: Gruels, mashes, green fodder, pulped roots. Wash mouth often with saturated boric acid, hydrogen dioxide, or potassium chlorate solution on swab. Drinking water constantly at animal's command. Clean, dry bedding. Feet washed with 2 per cent. lysol or creolin. Compresses wet with white lotion containing phenol, 1 per cent., constantly kept about coronets of cattle. Tar also applied to feet. Carbolized vaseline is used on the teats. Milk of patients unfit for food; boil 20 minutes before feeding it to animals. Two weeks after recovery, cleansing and disinfection of premises. During enzoötic, inoculation of saliva of patient into well animal will cause a milder form of disease.

Foot-Rot in Sheep.

Two forms, 1. Infectious, due to B. necrophorous. 2. Traumatic from long journeys over rough ground.

Segregate newly bought animals for three weeks. Isolate patients and treat by driving (thrice weekly) through foot baths of creolin 3 per cent. or ferrous sulphate, 4 per cent., or milk of lime. Furnish clean litter and dry quarters. If severe, treat feet locally by removing dead horn, applying ointment of cresol, 5; sulphur, 10; lard, 100; or carbolic acid in glycerin (1-10), or iodine or creolin ointment (5 per cent.). Cauterize fungous growths with pure phenol and protect parts with tar. In the form originating in bruises of sole, and purely traumatic, treatment consists in putting sheep on soft, dry pastures, cutting away dead horn and applying tar.

Founder. See *Laminitis.*

Foreign Bodies in Alimentary Tract. See *Choking.*

Dogs—When swallowing of foreign body is known to occur, give bread and porridge as diet. Cathartic 36 hours after ingestion, providing it is a blunt body. Remove from within anus if symptoms of straining and lodgement there. Abdominal section, if body not passed.

In ruminants the treatment is purely surgical.

Foul in the Foot of Cattle. Canker.

Often due to B. necrophorous. Isolate the sick. Lameness, swelling, heat and tenderness of claws with resulting abscesses, ulcers and sinuses about the heels and pasterns. Curette necrotic areas, apply Lugol's solution, and dust with calomel.

Avoid wet, dirty stables and litter. Remove all loose horn and expose sensitive diseased parts for treatment. May also apply carbolic acid in glycerin (1-10), 2 per cent. creolin or lysol, and protect with oil of cade or tar on tow and bandaging. Stimulate by applications of nitric acid, and dress with powdered alum and iodoform, or iodoform and tannin, equal parts.

Fowl Cholera.

Treat with acid. hydrochlor. dil. (m. v.), and ferrous sulphate (gr. v), or tannic acid (gr. v), in ounce of peppermint water; dose: ʒss. hourly for fowl; 1 teaspoonful for pigeons (Friedberger). Few drops of carbolic acid solution (5 per cent.) under skin. Prevent by isolation of well in new quarters. Burn dead and discharges. Before reoccupation of premises, hen yard must have surface soil removed and replaced by new earth. Thorough cleaning, disinfection and whitewashing of hen house.

Fractures.

Examine and set under anesthetic. Large animals, slings. Plaster of Paris or starch bandages or splints. In non-union, rub ends of bone together; or puncture ends of bones with drill; or suture with silver wire or chronic cat-gut. Compound fractures treated antiseptically through window in plaster of Paris splint. Fracture of jaw, rectal feeding.

FRONTAL AND MAXILLARY SINUS, DISEASES. See *Catarrh Chronic, Oestrus Larvae.*

FROST BITE.

Rub part with snow or cold water to gradually restore warmth—temperature of premises low for first twenty-four hours. In mild cases, rub on turpentine liniment. With vesiculation and destruction of tissue, treat as advised in burns of second and third degree. Ichthyol, glycerite of tannin.

FUNGUS HAEMATODES.

A sarcomatous growth protruding from the orbit in cattle and sheep, less often in horses.

Enucleate the eyeball and fatten for butcher.

GALL STONES. Also see *Colic.*

No medical treatment will remove gall stones when they are once formed in the gall bladder.

GALLS, WIND. See *Teno-synovitis.*

GANGRENE.

Apply antiseptics to wound, as compress wet with corrosive sublimate (1-3,000) while waiting for line of demarcation to form. Remove dead tissue by knife or actual cautery. Or apply bromine with glass rod, or phenol and glycerine (1-8), to slough. In moist gangrene, apply following paste: phenol (3ss.), powd. charcoal (℥ii.), glycerine (℥iv.). Tonics: tinc. of ferric chloride and quinine.

GAPES (In Poultry). See *Parasites.*

GARGET. See *Mammitis* or *Mastitis.*

GASTRITIS AND GASTRO-ENTERITIS. See *Indigestion, Acute.*

GASTRODUODENITIS. See *Jaundice.*

GID. See *Cœnurosis.*

GLANDERS.

After isolation of suspicious cases in a cow barn, the premises previously occupied must be most carefully cleaned, including harness, utensils, stable fittings, mangers, walls, floors, and disinfected. Exposed or suspicious cases tested with mallein, or 50 to 100 c.c. of blood withdrawn from the jugular by aspirating syringe or trochar and canula. The serum which separates should be sent to a laboratory for complement fixation test. All animals reacting to this test should be removed and killed and stable cleaned and disinfected.

The remaining animals should be retested by complement fixation test every 3 weeks until no more react and stable redisinfected after each test, including harness, stable utensils, fittings, mangers, walls and floors.

GLANDULAR SWELLINGS.

Into acute swellings inject phenol; or inject or apply externally iodine, to abort or hasten suppuration. Apply a mixture of icthyol and mercury and belladonna ointments and lard, equal parts, in acute and subacute cases, to aid resolution. May prevent abscess by fly blister. When abscess

inevitable, hot poultice. See also mercury and mercuric oxides. Red mercuric iodide. Internally, to avert abscess, calcium sulphide, sodium sulphite or yeast. See *Boils.*

GLAUCOMA.

In the inflammatory form, give a smart purge and low diet. Drop eserine sulphate solution (gr. iv to ℥i) in the eye thrice daily. After acute attack subsides, mild eserine solution (gr. ¼-℥i.). Iridectomy, in most cases.

In chronic form, weaker eserine solution (as above) and potassium iodide internally.

In traumatic form, treatment depends upon injury and is chiefly surgical.

GLOSSITIS, IDIOPATHIC OR TRAUMATIC.

Swab often with saturated solution of boric acid in boiled solution of starch or barley flour. Ice water at animal's command constantly. If much swelling and edema, scarification of the tongue superficially in many places. If difficulty in swallowing, rectal feeding or stomach tube through nose in horse. When tongue lacerated, save all of the organ possible, and suture. If caused by alkalies, use vinegar and water (1-2) on swab.

GLYCOSURIA. See *Diabetes Mellitus.*

GOITRE. See *Bronchocele.*

GRAPES. See *Grease.*

GREASE. Dermatitis seborrhoeica of pasterns and fetlocks in horses.

In the early stage apply white lotion or pink ointment (2 per cent.). To either, with fetid discharge, carbolic acid may be added. In the later stages, with copious greasy discharge, the hair should be clipped and the parts cleansed with soap and water and lysol solution (2 per cent.). Then balsam of Peru should be applied and a dry wool dressing and bandage. For exuberant granulations, use a powder of tannic acid and iodoform (1-3). When these become large and of fungoid character ("Grapes"), they must be removed by knife, scissors or white-hot shovel or firing iron and parts dressed first with gauze moistened with creolin solution (5 per cent.) and later with Peru balsam and dry dressing. In chronic swelling of the legs (Elephantiasis) with grease, give a course of tonics: iron, arsenic, bitters.

GROGGINESS. See *Navicular Disease.*

HAEMATEMESIS. See *Hemorrhage.*

HEART DISEASE, CHRONIC.

1. Valvular Lesions. 2. Enlargement (Hypertrophy, Dilatation). 3. Myocarditis, Acute and Chronic. Myocardial Insufficiency.

In Hypertrophy with violent action of the heart or palpitation, spirit of chloroform and tincture of aconite; also in palpitation, belladonna may be useful with aconite or bromides.

In palpitation, with feeble heart-beat and weak sounds, give digitalis, or strophanthus, or camphor. See *Nervous Palpitation of Heart.*

In valvular disease, with dyspnea, weakness, and other signs of failing compensation, give fluidextract of digitalis, or this with strychnine. As

substitutes for digitalis: strophanthus and caffeine. With high-tension pulse, combine nitro-glycerin with digitalis. With urgent dyspnea, give morphine.

In dropsy, give H. and C. aloes and salts; D., co. jalap powder (3ss). Also digitalis with squill and potassium acetate; see *Dropsy*. With dilated heart and urgent dyspnea and cyanosis, venesection. Atheroma as a cause of heart disease in the old is treated with potassium iodide (H., 3i; D., gr. x) thrice daily.

In chronic heart disease, rest, concentrated, nutritious diet, with water between meals and not directly before exercise, are indicated.

Myocardial weakness demands treatment as for valvular disease—rest, diet, stimulants, iodides. In myocardial weakness of over-fat animals, reduce fat. See *Obesity*.

In chronic heart disease with infrequent pulse, digitalis is contraindicated; use camphor, ether, alcohol or aromatic spirit of ammonia. When there is anemia, iron is of great value.

Heat Stroke. See *Sun Stroke*.

Hematuria.

Ice to loins. Aqua hamamelidis. Ergotin under the skin, or extract ergot internally. In hematuria of acute nephritis, after first week, give tinc. cantharis (H., 3ss; D., m.i) with same amount of fluidextract of cannabis indica. In bleeding from bladder, irrigate with adrenalin with 1-5,000 solution; also inject water at 120 deg. F. Urethral hemorrhage stopped by retention of catheter in urethra. If adrenalin stops bleeding, when injected into bladder, the source of the trouble is proven. Hematuria in young cows: This is enzoötic in low-lying pastures; change pastures, drain pastures and fertilize them with lime and phosphates.

Hemoglobinuria. Azoturia in Horses.

Support in slings in box stall. Empty bladder by pressure through the rectum or by catheter. Adrenalin solution intravenously or intramuscularly, 3ii-iv, purge with arecoline hydrobromide barium or eserine. Apply hot blankets. Venesection, and replace by saline infusion in strong animals. Allow normal salt solution to flow slowly into rectum to stimulate kidneys. In restlessness, chloral; with heart weakness, strychnine.

Diet—Bran mashes, hay, roots, green food, little hay. Prevent by light feeding, when not working, or by exercise every day.

Hemoglobinuria in Cattle. Texas Fever. Piroplasmosis.

This is caused by a protozoan parasite conveyed by ticks or their ova to cattle. *Prevention.*—Remove ticks from cattle by brushing or scraping them off; or by spraying cattle with following mixture: Dipping cattle (15 to 30 seconds) in this mixture in concrete or wooden vats 5¼ ft. deep and 40 ft. long is most successful in eradicating ticks in large numbers of cattle. Boil white arsenic (10 lbs.) and sal soda (25 lbs.) in 25 galls. of water for 15 minutes, or till arsenic dissolves. Cool with cold water to 140° F. and add 1 gall. pine tar gradually, while stirring. Bring the mixture to 500 galls. by adding sufficient water (U. S. Dept. Agic.).

Application of dip or spray must be made every 3 weeks till ticks disappear, or only twice (a week apart) when cattle can be placed in tick-free pastures. Cattle must not be dipped when tired or thirsty, or allowed to drip on grass or to form pools which they may drink. They must not be driven hard or overheated for a week after treatment. By keeping cattle in spring in tick-free inclosures, three weeks in each in turn, the ticks fall off and the cattle are not reinfested. The inclosures are then disinfected by spraying with kerosene and burning.

Freeing Pastures of Ticks.—Exclude animals from June to November. Cultivate or burn over pastures. Pasture rotation.

Treatment. Quinine and Urea hydrochloride.

Immunizing.—Young stock may be immunized by inoculation with 1-3 c.c. of defibrinated blood from an immune animal. The treatment involves a mortality about 7 per cent.

HEMOPHILIA.

In "bleeders," inject fresh normal horse serum or antidiphtheric serum (H., ℥iv; D., ℥ss) and make local application of adrenalin chloride solution or subcutaneous injection of it into bleeding part (1-10,000). Very hot or cold water, compression. Pure tannic acid. Internally, calcium chloride and gelatin.

HEMOPTYSIS. See *Hemorrhage.*

HEMORRHAGE FROM WOUNDS. See *Wounds.*

HEMORRHAGE, INTERNAL.

Quiet and rest of animal and bleeding part, with lowering of blood pressure in internal hemorrhage; opium. Infusion of salt solution after arrest of bleeding. Gelatin and calcium chloride to coagulate blood. Adrenalin chloride best hemostatic when can reach bleeding spot.

Subcutaneous injections of fresh horse serum (antidiphtheric serum is most convenient, but fresh serum is much more effective) has recently given most successful results in persistent hemorrhages of all kinds. The serum should not be repeated at intervals longer than 10 days. That from the same species of animal as the patient is best.

The dose is about ℥ss for small animals; ℥2-4 for large patients.

Gastric (hematemesis) and Intestinal (enterorrhagia) hemorrhage, hot blankets externally; ice water internally; and bandaging of the limbs.

In hematemesis, adrenalin by the mouth or Monsel's salt in pill (H., ℥i; D., gr. x) every fifteen minutes for an hour, if adrenalin is inefficient; or tannic acid: or ergot by mouth or subcutaneously.

In enterorrhagia, ergot, tannic acid with opium, or Monsel's salt, as above. Hamamelis. Diet, oil of turpentine in slight enterorrhagia.

In bleeding from rectum, enemata (H., Oi; D., ℥2-4). Enemata to contain either adrenalin (℥ss to Oi), Monsel's salt, or alum, or tannic acid (℥ss-Oi).

In Hemoptysis, amyl nitrite by inhalation, morphine under the skin, or chloral and bromide by mouth. Inhalation of Monsel's solution (℥ss-Oii). To prevent recurrence, give calcium chloride every 2 hours, and gelatin

by mouth. Also complete rest to avert pneumonia, and aconite to lower circulation. Ice applied to chest during hemorrhage.

Hemorrhage, Post-Partum.

Remove fetal membranes. Intrauterine injections of hot sterile water (115-120 deg. F.). Pack uterus with aseptic gauze. Ergotin subcutaneously. Raise hind quarters. Secure quiet by morphine under the skin, or laudanum by mouth. Tight binder about abdomen to support uterus. In laceration of uterus, tight packing of sterile gauze or suture. If severe bleeding, saline infusion. Strychnine under skin and alcohol, to avert collapse.

Hernia.

Umbilical Hernia in New-Born—Give purge, and, after 12 hours' fast, cast and return protrusion and draw 2 folds of skin together covering umbilical ring. The folds are held together by wooden or iron clamps, with not sufficient pressure to cause the skin to slough; or by skewers introduced down to fascia, on either side ring, and held together by string wrapped around folds of skin, not tight enough to cause sloughing.

Ventral Hernia—This occurs in any part of belly wall from injury to wall, except at natural rings. Treatment is not often required. If small, same method as for umbilical hernia may be used, or blister applied over protrusion. If strangulated or large, an open operation under strictest asepsis with return of contents of sac and suture of wall in layers, and overlapping of external oblique aponeurosis, may be done.

Inguinal Hernia—Rare in gelding; return bowel by taxis under anesthesia if possible, and apply clamps to skin as for umbilical hernia. If taxis fails, open operation with division of the ring must be done. In the stallion, covered castration operation, followed by clamps applied to skin, or suture.

Herpes, Pemphigus, Bullae.

A vesicular eruption at the juncture of the skin and mucous membranes, especially about mouth and genitals. Laxative in indigestion. In adult horses there may be pustulation. Tinc. camphor; a mixture of equal parts, starch and zinc oxide; bismuth nitrate as dusting powder; zinc ointment.

Hog Cholera.

Under this title three distinct diseases are sometimes confounded—1. Hog Cholera or Swine Fever, in U. S. and Great Britain. 2. Swine Plague or Contagious Swine Pneumonia. 3. Swine Erysipelas or Mal Rouge. Protection and, to some degree, successful treatment in hog cholera is now assured by the serum of hyperimmunized hogs. In erysipelatous form immunity which lasts a year is secured by vaccination with an attenuated virus, but is attended with 1-2 per cent mortality. Not common in U. S. Compulsory inspection and control; notification; isolation of diseased, suspects and new arrivals; examination of live and dead animals in markets; burning or deep burying of dead, with thorough disinfection of premises and feces, are indicated. Much the same course for all three diseases.

IMPACTION OF RUMEN IN SHEEP AND CATTLE.

To relieve tympany, puncture with trocar in most prominent point in left flank. Follow with daily doses of Glauber's salts and linseed oil, and fluidextract of nux vomica thrice daily, and light diet of hay and mashes. Or give subcutaneously eserine (C. gr. i), and pilocarpine (C. gr. ii), in urgent cases. In less urgent cases give the salts, nux vomica and mashes as above. In acute and chronic cases, gastrotomy is indicated when medical treatment is unsuccessful, except in febrile cases and old cows; not more than two-thirds of stomach-contents should be removed (Moussu).

INCONTINENCE OF URINE. See *Urinary Retention and Incontinence.*

IMPOTENCE, INABILITY TO COPULATE.

1. Loss of sexual desire and power (functional).—Regulate exercise and work, by decreasing or increasing, if either excessive. Avoid excessive or early copulation. Yohimbine hydrochloride. Give tinc. cantharis and fluidextract nux vomica well diluted, thrice daily.

2. Organic impotence—Growths, disease and malformations or paralysis rarely yield to drugs.

3. Premature ejaculation in male—Prevent masturbation and excessive copulation. Cold enemata and improvement in hygiene by outdoor life.

INDIGESTION, ACUTE, IN THE HORSE.

Includes Acute Gastro-intestinal Catarrh.

Use stomach tube with eructations, retching, pain and distension of stomach. With flatulence, aloes ball with calomel, (3ss). With violent pain, see *Colic.* Lysol (3iv) in ball of use in flatulence. Follow later with powdered sodium bicarb., ginger and nux vomica thrice daily. After an acute attack give HCl and fluidextract of nux vomica to stimulate gastric functions. When diarrhea is chief feature, give calomel (3ss) in a quart of linseed oil; then prescribe opium and tannic acid (each 3ii) twice daily in ball. If dysentery with straining and mucus, enema of 1 per cent. tannic acid. Diet—Fasting first 24 hours; then gruels, green food, chopped hay.

INDIGESTION, ACUTE, IN CATTLE. ACUTE GASTRITIS, RUMENITIS, RECTICULITIS, OMASITIS, ABOMASITIS.

Apply fly blister over affected stomach. In abomasitis, venesection (2-4 qts.) in severe cases. Eserine with pilocarpine under the skin. Daily doses of Glauber's salts. Nux vomica in convalescence. Diet—Gruels, milk, bran mashes and little hay.

INDIGESTION, CHRONIC. CHRONIC GASTRO-ENTERITIS (HORSE).

Diet. Attend to condition of teeth. Powder (sodium bicarb., ginger and nux vomica) thrice daily on feed. HCl in some cases. Carlsbad salts (℥i) on feed for constipation. Also daily, soapsuds enema. With diarrhea, copper sulphate or lysol (℥ss) daily with putrid feces.

INDIGESTION, CHRONIC, IN CATTLE. CHRONIC TYMPANITES.

Without diarrhea or constipation, give fluidextract nux vomica with Carlsbad salts (2 tablespoonfuls) on feed thrice daily. In constipation with mucus, add to Carlsbad salts sodium bicarb. With diarrhea, give HCl

HOOSE. HUSK. VERMINOUS BRONCHITIS.

Due to presence in the bronchial tubes of S. filaria in lambs; S. micrurus in calves.

Lambs—Internally, oil of turpentine (3i), or oil of turpentine and tinc. camphor; of each 3i once daily in milk; or creosote (℥ii), benzine (℥i), and water (2 qts.) in teaspoonful doses for week (Moussu) once daily. By inhalation—Calves, 3ii each of oil of turpentine and ether poured in each nostril of upturned head for one or more treatments (Read). Inhalation equal parts tar, sulphur and turpentine from kettle for 25 minutes for three treatments.

Intratracheal Injections—Calves, oil of turpentine (3ii), phenol (m.xx), with chloroform (3ss) for one injection. Generous feeding. Iron and bitters. Slaughter of severe cases.

HYDATIDS IN CATTLE AND SHEEP. See *Coenurosis.*

HYDROCELE (DROPSY) OF SCROTUM.

Distinguish from hernia by failure to reduce and translucency. Insert hypodermic needle, and then completely empty with aspirator or fine trocar. Screw on hypodermic syringe to needle and inject pure phenol (m. x-xxx small animals; 3ii or more in large animals). In failure to cure, open scrotum, swab tunica vaginalis with pure phenol, and drain.

HYDROCEPHALUS (DROPSY OF LATERAL VENTRICLES). SLEEPY STAGGERS.

In Horses; rare in Cattle, Dogs and Swine. Impossible to effect a cure. General care as to excess in exercise, with laxative, restricted, nutritious diet. Quiet and cool quarters. Potassium iodide. Tap lateral ventricle.

HYDROPHOBIA. See *Rabies.*

HYDROTHORAX.

Purge with concentrated solution of salts in large animals; in dogs, give co. jalap powder (3ss) in capsule.

Internally, digitalis and oil of juniper, and sweet spirit of nitre thrice daily to horse. For dogs, calomel and digitalis. Also give strychnine as heart stimulant.

Externally, applications of mustard paste. Pilocarpine (Friedberger) subcutaneously. In severe dyspnea and in large effusions, aspirate pleural cavity.

IMPACTION OF COLON IN HORSE. See *Colic from Impaction.*

IMPACTION OF OMASUM, DRY MURRAIN, FARDEL BOUND, STOMACH OR GRASS STAGGERS.

In Cattle; more rarely in Sheep and Goats. Epsom and common salt, with croton oil (C., m. xx). In non-febrile cases, two or three pails of linseed tea daily. Eserine (gr. i) with pilocarpine (gr. iii), in urgent cases given under the skin. Enemata—Fluidextract of nux vomica thrice daily. With head symptoms, ice to poll. After free purgation, give sloppy food with plenty of salt and continue nux vomica thrice daily.

(3i-iii) in drinking water twice daily, and nux vomica and salt on feed. When blood in feces, give fluid diet (milk and gruels) and sodium bicarb. on food.

INDIGESTION IN CALVES. MILK INDIGESTION. ABOMASAL INDIGESTION.

To stop vomiting and diarrhea, use only sterile, feeding utensils and clean warm milk in hand-fed patients. In sucklings, see that mother's milk is not over rich and feed at short intervals. Skim milk from creameries must be scalded. In hand-fed, give scalded milk and pure water (half and half) mixture, warmed, till digestion good. At onset, castor oil (℥ii). Pepsin, scald utensils after feeding. Do not give meal at too early age.

See also *Enteritis* in Calves.

See that udder and perineum of mother are clean in sucklings.

INDIGESTION, ACUTE, IN SWINE. ACUTE GASTRITIS.

Calomel and tartar emetic (each gr. v) or calomel (gr. v) and ipecac (gr. xxx) in pill with meat. To check severe diarrhea, chalk (3ii) or bismuth subnitrate (3ss) on food thrice daily. Avoid improper food, sour swill, hotel washings, etc. Give boiled milk and gruels. Clean utensils, trough and pen.

INDIGESTION, ACUTE. ACUTE GASTROENTERITIS IN DOGS.

Restrict water and starve patient. Encourage vomiting by fluidextract ipecac (3i). If emesis prolonged, bismuth subnitrate and cerium oxalate in capsules. Also potassium bromide (3i), with chloral (gr. xx-xxx) in enema in boiled starch solution. Diarrhea is checked by castor oil (℥i-ii), followed by bismuth (gr. xx), and salol (gr. v) with food thrice daily; or pills of lead acetate (gr. i), and camphor and powd. opium (each gr. ss), three times a day. Enemata (1 per cent. tannin) if much straining. Diet—Milk and lime water; raw scraped beef. In diarrhea, boiled milk and rice. In convalescence, tinc. nux vomica thrice daily.

INDURATION.

Apply Priessnitz poultice. Rub into parts frequently, equal parts, ichthyol, ung. hydrargyri and ung. belladonna, or employ a fly blister. Fibrolysin.

INFLAMMATION.

Acute—General treatment with aconite, veratrum, or, in robust patients and with very urgent symptoms, venesection. Cool, airy, box stall, moderate body covering and bandage for limbs, in case of horses. Internally, laxatives. Calomel is an intestinal disinfectant as well. Externally, counter-irritation in some form. When trouble localized, hot poultices or ice. To relieve pain and quiet animal, opium, bromides, chloral. Stimulate renal secretion: spirit of nitrous ether, potassium citrate, or nitrate. Diet. Stimulants to support the heart, strychnine. In convalescence, bitters and alcohol, HCl.

In Chronic inflammation, supportive treatment. Internally, iodides to aid resolution. Externally, in local troubles, counter-irritants.

INFLUENZA IN HORSES. DISTEMPER. PINK EYE.

Cool, airy box stall. Moderate covering of body and bandaging of limbs. Clean and disinfect floors, walls and feed boxes daily. Provide separate attendants for sick. Move bowels by enemata or mild laxatives. Diet —Bran mashes, boiled oats, milk, beef tea, eggs, green food. Strychnine solution dropped on tongue thrice daily and turpentine liniment rubbed daily onto limbs and belly to prevent edema. Steaming with co. tinc. benzoin and application of turpentine liniment and bandage to throat, to relieve catarrh of upper air passages. With laryngitis, apply fly blister to larynx. With weak, feeble pulse, give strychnine as above and alcohol, as gin and digitalis; or strophanthus, or camphor, or caffeine, or coffee. Antipyretics rarely desirable, except in hyperpyrexia, then a few doses of phenacetin (3ii) at 3 hours' interval. Spirit of nitrous ether, aconite, and solution of ammonium acetate may be given. Alcohol as food and nerve sedative. With icterus, give 1 pint of linseed oil and sodium bicarbonate on food. When conjunctivitis, keratitis and iritis complicate, see these disorders. Influenza antitoxin is of great value as a prophylactic, and of less worth as a curative agent. Also diphtheria antitoxin (Immunizing Serum for Influenza, Mulford) in 20 c.c. acts as prophylactic and curative agent in first stage when temperature begins to rise. Polyvalent Antistreptococcic serum as a prophylactic (10 c. c.) and curative agent (dose, 30 c. c.) has yielded good results and is said to prevent purpura. Suspects showing rise of temperature and all cases of influenza should be isolated. Communication of influenza by utensils and attendants should be avoided. Disinfect premises when cases no longer exist. For special complications, as Pneumonia, Purpura, Enteritis, Cerebral Hyperemia, Paraplegia, Synovitis, Laminitis, etc., see titles of these disorders.

INTERFERING.

Improve the general condition and shoeing. Set shoes a little away from inner margin of feet or employ three-quarter shoe, or a shoe thin on inside web, without heel on outside. Apply an interfering strap on fetlock which is struck.

INTERTRIGO. See *Erythema.*

INTESTINAL HEMORRHAGE. See *Hemorrhage, Enterorrhagia.*

INTESTINAL INDIGESTION AND CATARRH. See *Indigestion and Enteritis.*

INTUSSUSCEPTION OR INVAGINATION. See *Colic.*

IRITIS.

Darkened quarters. Brisk purge. Hot fomentations to eye for one-half hour thrice daily. Two or three leeches on temples, after shaving hair. 1 per cent. atropine solution four to six times daily in large animals; m. i three times daily in smaller animals; dropped in the eye. Internally, sodium salicylates and potassium iodide in acute rheumatism. Enucleation of an injured and useless eye when it threatens sympathetic iritis in the other. Iridectomy for sequels of iritis, as occluded pupil or posterior synechiae.

JAUNDICE. GASTRO-DUODENITIS. CHOLANGITIS. IN DOGS AND HORSES.

Priessnitz poultices over liver.

In dogs, calomel at outset, and bismuth subnitrate, and sodium bicarb., thrice daily in capsules. Diet, skim milk and lime water, lean meat, broths and bread. Massage over gall bladder and cold enemata.

In the horse, artificial Carlsbad salts on feed thrice daily. Diet—Green fodder, pulped roots, boiled potatoes, steamed and cracked oats. An abundance of water.

JOHNE'S DISEASE. See *Dysentery.*

KERATITIS. ABSCESS AND ULCER OF CORNEA.

Brisk Purges. Quinine in good doses. Extr. opii (gr. x), boric acid (gr. lv) in water (℥iv), on gauze and oil silk. bandaged over eye. Atropine (gr. i-iv to ℥i) dropped in eye thrice daily (stronger solution with much photophobia and lachrimation) with application to lids of yellow oxide of mercury ointment (gr. iv-℥ss). Or holocain hydrochlorate (gr. ii-℥i) in place of atropine. In spreading ulcer, apply very carefully pure phenol to cocainized eye on a toothpick. Then flush eye with normal salt solution (℥i i-Oi). Fine galvano-cautery may be used instead. In abscess of cornea and pus in anterior chamber, rarely advisable to incise.

KERATOMA AND KERAPHYLLOCELE.

Horny tumor from sole or horny laminæ of horse's foot. Excision and antiseptic dressings. Recurrence is frequent.

LAMINITIS, HORSES AND CATTLE.

Horses—Remove shoes, thin horn on soles and place in well-bedded box stall. Let animal stand several hours at a time in hot water (frequently changed) and apply poultice in intervals. Or use cold water foot baths and ice poultices with bran. Diet. Give aconite, or bleed from jugular or toe in severe cases. Inject adrenalin, employ enemata and linseed oil, and encourage animal to lie down, or cast or sling in very acute cases. After subsidence of acute inflammation, keep heels low and toe short, apply thick, wide, rocker, bar shoes; exercise in soft, wet ground and apply blister to coronet. Neurectomy for prolonged lameness.

In Cattle, same general treatment. Full dose of salts and mustard to chest at the beginning.

LARYNGITIS, ACUTE.

Chiefly in Horses and Dogs.

Locally, cold wet compress applied to throat and covered with oiled silk; or thick coat of antiphlogistine; or ice bag; or turpentine and sweet oil (equal parts); or, in severe cases, mustard paste or fly blister. Steam inhalations with 2 per cent. carbolic acid solution. Internally, tinc. aconite with spirit of nitrous ether every few hours for fever. Laryngeal cough and spasm relieved by morphine or Dover's powder (horse), and by codeine (dogs).

LARYNGITIS, CHRONIC.

Chiefly in Horses and Dogs.

Locally to throat, wet compresses, antiphlogistine or stimulating turpentine liniment, as above.

Dogs—Application to larynx of 2 per cent. silver nitrate solution on human applicator, or inhalations of benzoin and ipecac. Also insufflation of larynx with bismuth and orthoform equal parts with powder-blower.

In the horse, injections into the larynx, through the crico-tracheal ligament, with a hollow needle (1-2 per cent. solutions of alum or lead acetate) are most effective. Also give ammonium chloride and Carlsbad salts on the feed thrice daily.

LARYNGITIS, MEMBRANOUS.

Chiefly in Cattle, occasionally in calves, lambs, pigs, dogs and cats, see *Croup.*

Bleed from jugular (1-6 qts.), or give tartar emetic (ʒii-iii) in strong animals at onset. To throat, hot poultices frequently changed, or sinapisms. Potassium iodide thrice daily. Salts on feed, Diet—Mashes, green food and milk. Tracheotomy in threatened suffocation. In dogs and cats, give dram doses of syrup of ipecac in threatened asphyxia. Edema of the glottis occurs as result of acute laryngitis and proves rapidly fatal unless tracheotomy is done.

LEUCORRHEA. See *Vaginitis, Septic Metritis, Metritis, Puerperal Fever.*

Symptomatic treatment with injections of 1 per cent. liq. cresolis co., 1 per cent. sol. of alum, or zinc sulphate. Iron and gentian in young and under-nourished. Generally secondary to endometritis, metritis, contagious abortion, tuberculosis, granular and B. necrophorous vaginitis, etc.

LEUKEMIA.

Rare in Horses, Cattle, Swine, Dogs and Cats. Generally fatal. Fowler's solution of arsenic pushed to fullest extent—H. and C., from ʒss to ʒii; D., from m.v to m.xxx, twice daily. Otherwise the treatment is as for *Anemia, Pernicious.*

LICE, PEDICULOSIS, PHTHIRIASIS.

Horse: *Hæmatopinus macrocephalus, Trichodectes pilosus,* and *T. pubescens.*

Cattle: *H. eurysternus,* large ox-louse; *H. vituli,* calf-louse; and *T. scalaris,* small ox-louse.

Sheep: T. sphærocephalus. The pupiparous dipteran, *Melophagus ovinus,* ked or fag, also infests the skin of the sheep.

Dog: *H. piliferus,* and T. latus. Cat: *T. subrostratus.*

Pig: H. urius.

Goat: *H. stenopsis* and *T. climax.*

Fowls. *Goniodes dissimilis, Gonicoctes hologaster, G. gigas, Lipeurus variabilis, L. heterographus, Menopon pallidum, M. biseriatum.*

In large animals, apply pure kerosene night and morning for two days, then wash off with soap and water. Hair washed with vinegar for a few days to remove nits or eggs. In dogs, use tinc. staphisagria, or oil of anise in sweet oil (1-10); also creolin in 5 per cent. solution; and corrosive sublimate in 1 per cent. solution, applied in spots and carefully

dried, may be used. Blue ointment often applied in cattle, but not if there is dermatitis. When the animal is greatly infested and the hair is long, the hair may be clipped, but this is usually not necessary. In sheep, use dip as for scab. Fowl. Sulphur may be used in nests or dust that or pyrethrum in feathers. Apply kerosene to roosts and nests. Wash floors and sprinkle with sulphur. Whitewash walls. Keep hens out of stable to prevent hen lice from infesting horses. Isolate infested animal till cured and disinfect its former quarters. Employ general cleanliness and generous feeding.

LICHEN. See *Eczema.*

LICKING HABIT. See *Depraved Appetite.*

LIP-AND-LEG ULCERATION IN SHEEP.

Enzoötic, communicable, due to B. necrophorus. Cuts, bruises and abrasions about mouth and limbs exciting cause. 1. Lips swell and covered with papules, pustules and scabs, nasal discharge and conjunctivitis. Nose and lip sloughs. May be similar lesions about coronets and pastern joints and fold of fetlock. Lameness ensues. Chin, cheeks, gums, roof of mouth, feet, penis, vulva, udder, may be attacked by necrotic process.

2. In lambs. Sudden swelling of lips, warty patches or fissured crusts on lip and muzzle with suppurating ulcers underneath. Necrotic areas at corner of mouth. Usually heal in time.

3. Venereal. Angry ulcerating sheath, and penis sometimes swollen and ulcerated. In ewes ulceration about perineum, vulva, and anus.

4. Foot rot. Ulceration about cleft and claw with foul, purulent discharge.

Prevention. Isolate newly-bought animals for 2 weeks and frequent examination of exposed with segregation of sick. Disinfect infected premises, remove manure and surface soil from corrals and disinfect with saturated chlorinated lime solution. Transfer healthy sheep to new pastures and bed grounds. Frost kills bacteria in pastures.

Scrape off crusts and scabs with sharp stick and apply cresol, 5 parts; sulphur, 10; and lard, 100. Apply thrice weekly to ulcerations nitric acid (1 to 70), after removing scabs, and follow with ointment as above. In foot cases same treatment or drive sheep through 5% cresol solution thrice weekly. Venereal lesions clip wool and apply lysol solution (2%) daily and stimulate occasionally with nitric acid solution. On warty lips in lambs, use 5% cresol ointment and swab sore mouths with 2% potassium chlorate. Resistant cases killed. Dip sheep in 5 per cent. cresol solution before returning to flock.

LITHIASIS. See *Calculi.*

LIVER ROT IN SHEEP. (Occasionally in Cattle.)

Due to Distomum hepaticum and other species of Distomata or Fluke Worms, Order, Trematoda. Aspidium is of some value, treatment chiefly preventive. Give concentrated, dry food with plenty of salt. Avoid overstocking pastures or give up pastures, if seriously infested. Sprinkle lime and salt or copperas (250 to 400 lbs. to the acre) on pastures from May to August. Drain pastures to destroy snails, the intermediary host of

the Distomata. Diseased animals should be slaughtered and their livers burned. Keep sound sheep away from infested pastures. Disinfect manure of infested animals with quick lime.

LOUPING ILL IN SHEEP.

Due to bacteria conveyed by ticks living in tall grass and damp spots. No cure; treatment wholly preventive. Isolate and kill diseased sheep. Dip the rest of flock as for Scab. Wet pastures avoided or drained. Long grass and rushes must be avoided.

LUXATIONS. See *Dislocations.*

LYMPHANGITIS. CELLULITIS. INFLAMMATORY EDEMA.

Idiopathic in Horse in hind legs. Apply from the beginning hot compresses of 2 per cent. lysol or creolin solution, covered with waterproof protective and bandage, to whole limb; change frequently. Give aloes, 3iv, calomel, 3i, in ball, and light diet—mashes, green food and hay. Enforce absolute rest. Tinc. of aconite and spirit of nitrous ether may be used for fever every two hours, but local treatment most useful. Alcohol and milk in debilitated subjects. When acute symptoms subside, use dry bandaging, friction with oil of turpentine and sweet oil (equal parts), and gentle exercise to reduce swelling of limb. Internally, potassium iodide may be given to hasten resolution, together with laxatives to remove water from the system, as artificial Carlsbad salts on the food.

LYMPHANGITIS, Mycotic or Epizoötic, of Horses.

Excise or remove limited area of diseased lymphatics with actual cautery and knife. Incise, curette and cauterize abscess cavities with Paquelin cautery. Isolate diseased animals and disinfect harness, contaminated objects and premises contaminated by affected animals.

LYMPHATICS, INFLAMED. See *Glandular Enlargements.*

MAGGOTS FROM FLYBLOW.

Apply kerosene, or turpentine and oil. Other antiseptics.

MALADIE DU COIT. DOURINE IN STALLIONS AND MARES CAUSED BY TRYPANOSOMA EQUIPERDUM.

Prevention. Kill the diseased mares, and kill or castrate the diseased stallions.

Kill, or quarantine for three months the exposed stallions. Quarantine and inspect frequently the exposed mares. Medical treatment is rarely advisable in the United States. Avoid sexual excitement or copulation of patients.

Seen in stallions and mares. 1. Vesicles, ulcers and swelling of penis, urethral discharge and swelling of inguinal glands, edema of belly and legs, and often orchitis. Mares, vesicles, papules and ulcers about vulva, congestion and vaginal discharge. Animal acts as if in heat. White, puckered scars left on vulva. 2. After 2 months to year weakness, emaciation and paraplegia occur. Gait is swaying, there are large urticarial swellings, pruritus, and discharge from nose and eyes. Does not occur in geldings.

Treatment. Kill diseased mares, castrate infected stallions, castrate or isolate exposed stallions and frequent inspection of exposed mares. Cas-

tration cures if done before nervous symptoms appear. Copulation starts up disease in mares when apparently well. The U. S. Gov't enforces above treatment. Where medical treatment allowable may use antiseptic irrigations of penis and vagina. Stallion, 2 per cent. lysol or creolin, or 1-2,000 solution of corrosive. In mares, injections of 2 per cent. lysol. Also apply local application of 5 per cent. argyrol solution after cleansing as above. Great swelling is reduced by constant hot fomentation (saturated boric acid solution), or by incisions. After acute conditions subside, may inject sheath and vagina with 1 per cent. lead acetate or zinc sulphate solution, and use black wash externally. Treat ulcerations with 10 per cent. silver nitrate solution. In the beginning, sloppy food, mashes, green food and milk may be given. Iron and arsenic are indicated. With the appearance of emaciation, urticaria or paresis, give twice daily under the skin for 5 days sodium cacodylate (gr. x), followed by an intermission of a week. Also give strychnine thrice daily. The treatment must be persisted in for months; three years should elapse before a stallion is safe for service. Vesicular Exanthema may be treated locally, as advised for Dourine, but often disappears spontaneously.

Malignant Catarrhal Fever in Cattle.

Prophylaxis: clean, dry, well ventilated stables and removal of infected soil under barns. Isolate sick and disinfect discharges. Give creolin (3ii) twice daily in a pint of milk. Irrigate nose with 2 per cent. lysol solution; eyes with saturated boric acid solution. Soft diet with milk and gruels. Enemata or laxatives.

Mallenders and Sallenders in the Horse. Squamous Eczema. See *Eczema.*

Attacks flexures of hock and knee. Soak over night in sweet oil. Wash next morning with green soap and warm water, to remove scales. Apply oil of cade, liquid tar, or creolin, in alcohol (1-10). Carlsbad salts on the food. Regular exercise. Arsenic and iron.

Malnutrition. See *Debility.*

Malta Fever.

In goats and sheep, occasionally solipeds, ruminants, dogs, cats, rabbits, rats, fowl and duck. Has occurred in this country in Mississippi valley region. Infection through milk and urine and by copulation with infected animal. Infection also by food and bedding contaminated with urine. Possible that dust and mosquitoes convey the infection. In man infection is gained by ingestion of infected goat's milk, and vegetables contaminated by animals. Also by direct exposure to infected animals. Abortion in fourth month in goats and sheep and failure of lactation with lameness, vaginal discharge and conjunctivitis. Orchitis and lameness in rams and goats. Absence of symptoms in other animals. Causes severe and prolonged febrile illness in man. Diagnosis by agglutination test of serum of infected animal.

Prophylaxis only of importance. A vaccine is still in the experimental stage. Animals showing symptoms should be killed and premises thor-

oughly disinfected. All suspected animals must be tested by the agglutination test.

Those reacting should be quarantined until test negative. Flesh of killed animals may be used for food under supervision. Milk from infected animals must be pasteurised before use. Herd restocked with immune progeny of infected animals, or from uninfected regions.

Entire males in infected regions should be tested before copulation is permitted, if they react they should be castrated and quarantined until the test is negative.

The removal of animals from infected districts must not be permitted.

Infected solipeds should be isolated from other animals, although they may be worked.

MAMMITIS. MASTITIS. GARGET.

At onset, milk every hour and give frequent massage of udder with full dose of Glauber's salts and common salts. In no case of mastitis is the milk fit for human consumption, it may be boiled for animals, in mild cases, or else boiled and thrown away. Restrict food and water. Attend to abrasions of teats. (See *Teats, Fissured,* etc.) Also, to abort, either use constant hot fomentations or ice bag, and support udder by bandage and wide band about body. The surgeon should cleanse udder thoroughly and irrigate each quarter of the udder with warm 3 per cent. borax solution through sterile milking tube, in parenchymatous form. After gentle manipulation, draw off fluid in 15 minutes. If suppuration threatens, apply mercury binodide ointment (10 per cent.). With interstitial form and surrounding edema, puncture swelling in points by actual cautery, avoiding the veins. Then apply boric acid ointment (10 per cent.). For suppuration of udder, incise and drain, and, if severe, amputate in part or altogether. In chronic suppuration, the pus poisons the milk; remove teats with scissors for drainage; fatten and kill. Separate milkers in mammitis to avoid infection of sound cows. To prevent mammitis, cleanliness of animal and premises; use of proper stalls, so that teats are not stepped upon; immediate treatment of abrasions of the teats.

MAMMITIS, CONTAGIOUS STREPTOCOCCUS.

Curdling of milk on standing, later hard nodule above teat and milk thin and blue. Segregate diseased cows and provide separate milker for them. Cleanliness of udder and compelling milkers to wash hands after each cow is milked will prevent spread of the disease. After isolation of sick, disinfect premises and keep newly-bought cows away from exposed cows and infected stable for a month.

Treat mild cases with warm injection of 3 per cent. boric acid solution in teats. In more severe cases use one per cent. sodium fluoride. Chronic mastitis due to tuberculosis, actinomycosis, botryomycosis. Also mastitis caused by colon bacilli, B. necrophorous and staphylococci.

MANGE. ACARIASIS. SCABIES. ITCH. SCAB.

In the Horse—Sarcoptes scabei, beginning on head, neck and shoulders. Also Dermatodectes communis infesting inner thighs, root of mane and tail, sheath; and Symbiotes equi, seen on feet and pasterns. Clip hair, apply cottonseed oil with 5 per cent. creolin over night. Remove scabs

with green soap and water next morning. Rub in one of the following remedies with brush and, when rubbed off by animal, reapply daily for a week. Then wash off and after a few days, repeat the treatment two or three times. Use liquid tar and sulphur, each ℥i; soft soap and alcohol, each ℥ii; or creolin and soft soap each ℥i; alcohol ℥viii (Frohner). Also balsam of Peru and sulphur ointment, (1-7), 3 per cent. lysol or creolin solutions. Ointments in localized mange. In dermodectic and symbiotic mange, milder remedies—Peruvian balsam, carbolic soap, or creolin and glycerin (1-10).

In Dogs—Follicular mange, caused by Dermodex foliculorum, var. canis, attacks head, neck and limbs, invading hair follicles and sebaceous glands; very difficult of cure. Sarcoptic mange, caused by Sarcoptes squamiferus, attacks head, chest, belly, elbows, root of tail and claws, and spreads to whole body. Readily cured. Isolate to prevent spread to man or dogs. Apply muzzle and clip hair over lesions. In sarcoptic mange, Peru balsam and sulphur ointment (℥i-℥i), or 1 part each, liquid tar and soft soap, and 8 parts of alcohol. For follicular mange, weeks or months are required and result is doubtful. Shave hair from affected area. Give bath of potassa sulphurata (½ of 1 per cent.) for 15 minutes; follow by friction with pure Peru balsam. Creolin in 2 per cent. bath, followed by friction with equal parts creolin and alcohol, once or twice daily. Squeeze pus from all pustules. Try staphylococcus vaccine for suppuration.

MASTURBATION. ONANISM.

Dogs and Rams; Bulls and Stallions.

Regular exercise or work, and light diet. Punishment; moderate amount of copulation. Castration, if habit incurable.

MEGRIMS. See *Vertigo, Blind Staggers.*

MELANOSIS. MELANOTIC SARCOMA.

Seen chiefly in grey horses. Remove by knife; recurrence rather the rule.

MENINGITIS. See *Encephalitis and Cerebro-Spinal Meningitis.*

METRITIS, ACUTE AND CHRONIC. See also *Puerperal Fever or Septic Metritis.*

Examine uterus with speculum. Treatment purely local and takes time and money. Animal may recover spontaneously at pasture. Otherwise, irrigate with 2 per cent. lysol solution daily. Apply Churchill's tinc. iodine to lacerations of cervix and eroded os; or light application of actual cautery. Also dilate cervix and curette uterus, followed by loose packing with iodoform gauze for a few days. Afterwards daily lysol irrigations.

MUSCULAR RHEUMATISM.

Warm covering. Give a purge: H., physic ball, C., Glauber's salts, D., two compound cathartic pills. Rest of affected parts. Give sodium salicylate and potassium iodide in combination, to dogs in capsules, large animals in solution, thrice daily. Or the iodide may be reserved for subacute and chronic cases. Externally, rub into affected part methyl salicylate or chloroform liniment. Heat is also very efficacious; hot wet blankets covered with rubber sheet and dry blanket, or apply dry blanket and iron over it with hot flat iron. Puncture of affected muscles with sterile

needles, or injection of sterile water, sometimes effective. Shoulder lameness—Inject veratrine into muscle (H., gr. ¾ to 1½ in alcohol, m.xxx), followed by walking exercise. Chronic cases—Tonic treatment; cod liver oil; massage with liniment, moderate exercise and attention to hygiene.

MYALGIA, MYOSITIS. See *Muscular Rheumatism.*

MYOCARDITIS. See *Heart Disease.*

NAGANA OR TSETSE—FLY DISEASE.

Horses, Cattle and Dogs. Caused by Trypanosoma Brucei conveyed by Glossina morsitans or tsetse fly.

Arsenical preparations as atoxyl, sodium cacodylate most useful.

NASAL CATARRH OR RHINITIS, CHRONIC. GLEET (In the Horse).

Use cleansing, antiseptic, astringent solutions by atomizer, or fountain syringe and rubber tube in nostrils, by trephining chambers above, or by stomach tube introduced through posterior nasal openings. Cleansing and antiseptic solution, sodium bicarbonate and biborate (of each, 3iiss to Oi), with 3i tinc. iodine. Dobell's solution. Astringents, cupric sulphate or alum (½ per cent); tannic acid or zinc sulphate (½ per cent. solution). Solutions changed each two weeks. Outdoor life, feeding off ground; good food; bitters and iron. Isolation, unless glanders can be surely excluded. Gleet very often secondary and due to ulceration of pituitary membrane, carious teeth, facial sinusitis, glanders, catarrh of guttural pouches, tumors, parasites, abscess, etc. Employ a rhinoscope and inject mallein or use complement fixation or agglutination test. Discharge from one nostril is not usually simple gleet.

NAVEL DISEASE. See *Umbilical Infection.*

NAVICULAR DISEASE (in Horse).

In acute cases remove shoes and use foot bath of hot or cold water, for hours at a time, with flaxseed poultice each night. Give green food, mashes and hay. Prescribe a physic ball. When heat and tenderness in foot subsides, apply fly blister about coronet after clipping hair. Shoe with rubber pad (shoe thick at heels and thin at toe), after a few weeks of rest. If lameness persists, plantar neurectomy may be done in animals with good feet and limbs.

NECROBACILLOSIS. *See Lip-and-Leg Ulceration in Sheep.*

NEPHRITIS, ACUTE. (In Horses, Cattle and Dogs.)

Prophylaxis—In acute infections, avoid draughts, and use warm covering for patients; enforce rest, secure activity of bowels and skin and give abstemious diet. In acute nephritis, withhold all food and drink for the first few days. Diet—D., milk; large animals, mashes, green food and milk, after starving period. Give aloes ball (horse), Glauber's salts to cattle; co. jalap powder to dogs (3i) at onset. Hot blankets over whole body and mustard paste over loins. Pilocarpine under skin in a single dose, with strychnine. With marked hematuria, fluidextract ergot thrice daily. In later stages, as a diuretic, tinc. digitalis with potassium citrate. In convalescence, tinc. ferric chloride. Uremia is combated by cathartics

and venesection; and convulsions by chloral hydrate, chloroform inhalation and morphine under the skin.

NEPHRITIS, CHRONIC. (All Animals.)

Tinc. chloride of iron and sweet spirit of nitre thrice daily. In dropsy, see *Dropsy*. Withhold common salt from the food. Protect animal from exposure to cold. In dogs, chiefly milk diet. In Uremia, treat as recommended for *Acute Nephritis*.

NEPHRITIS, SUPPURATIVE. PYELO-NEPHRITIS. PYELITIS.

Seen in all animals; often in Cows and Mares following septic parturient states. In Cattle it is often best to fatten and slaughter. Secure drinking of large amounts of water by placing an abundance of salt upon food. In early stage, spirit of nitrous ether and potassium acetate thrice daily. Hexamethylenamine, best remedy in all stages of disease. When urine alkaline, give sodium benzoate to large animals; to small animals, give urotropin with salol and boric acid, as urinary antiseptics. In chronic conditions in dogs, give sandalwood oil in capsules (m.x). In large animals in chronic pyelitis, give fluidextract buchu. Accompanying anemia is treated with strychnine and tinc. of ferric chloride on the tongue. Isolation of patients is desirable to prevent infection of parturient animals.

NERVOUS PALPITATION OF THE HEART.

Seen in Horses and Dogs from over-exertion, indigestion, "nervousness." In severe cases, morphine under the skin. Also spirit of chloroform in less urgent cases. Or chloral and potassium bromide may be given. In asthenia and over-exertion, especially with irregular pulse, prescribe tinc. digitalis with tinc. aconite thrice daily. In anemia, give ferrous sulphate and nux vomica to horses. Indigestion, as a cause, demands a physic and restriction of food.

NETTLERASH. SURFEIT. HIVES. See *Urticaria*.

NEURALGIA. NEURITIS.

Give laxatives, especially castor oil. In debility and anemia, give strychnine in increasing doses; also iron, arsenic and phosphorus in combination (in pill or otherwise). Locally, freeze nerve with ethyl chloride spray, or apply Priessnitz poultice, or menthol, or blister over root of, or along course of, nerve, or nerve-stretching or cutting. Potassium iodide in rheumatic cases. To simply relieve pain, morphine injected locally under the skin, antipyrin, internally. Aconitine locally, gelsemium internally. In wound or injury, apply antiseptic poultice. In asthenia, see *Debility*.

NYMPHOMANIA. See *Sexual Excitement*.

OBESITY.

Diet the chief remedy. In dogs, tablets of dessicated thyroid gland, (gr. v. each) thrice daily. Restlessness and palpitation show overdosage; otherwise increase above dose. Potassium iodide, after meals thrice daily. Daily laxative and exercise.

Oesophagus. (Dilation and Obstruction. Inflammation and Paralysis.)

In dilatation, feed frequently with small amounts of concentrated and soft food. Resect œsophageal pouch.

In obstruction—If foreign body, give soft food. In dogs, pass a bristle probang or coin catcher; in horses, use stomach tube and stilet and inject water. Or expose gullet and ligate (temporarily) gullet about stomach tube, above obstruction, and forcibly inject water. Oesophagotomy. Apomorphine subcutaneously in dogs, but dangerous.

Inflammation of œsophagus due to irritants—Give linseed gruel with 1 per cent. boric acid, cold milk. Externally, Priessnitz poultice. Later, rub externally with equal parts oil of turpentine and sweet oil.

In paralysis, apply fly blister, give strychnine internally, pass sound.

Oestrus Equi. See *Bots.*

Oestrus Larvae in Accessory Sinus's of Sheep. False Gid or Sturdy. Gadfly Vertigo.

Treatment is unsatisfactory. Tar on nose of sheep to prevent entrance of gadflies. Impossible to insufflate or inject agents to expel larvae. Early slaughter often most satisfactory. Trephine either side of medium line between eyes and remove with forceps and irrigation (2 per cent. lysol), or by injection of a little benzine and water (Moussu).

Omphalophlebitis. See *Umbilical Infection.*

Opacity of Cornea. See *Corneal Opacities.*

Open Joint.

In recent wound, shave adjacent parts, wash them carefully with soap and water and 70 per cent. alcohol. Douche wound with force for 15 to 30 minutes, using corrosive sublimate (1-2,000), or lysol (2 per cent.), or other antiseptic solution. Often best to simply cover puncture with sterile gauze, shave hair away without wetting skin, wash skin with gasoline, and then swab wound and surrounding skin with tincture iodine. Then suture and close wound with iodoform collodium (1-10), sterile gauze and bandage, if latter possible. If suturing impossible, apply fly blisters about joint. If bandaging is not feasible, apply constant cold antiseptic irrigation to the joint for next few days. Try Bier's hyperemia. Remove shoes from horses and place in slings. Prescribe purge. Whenever possible, place over bandage a firm plaster of paris, wood or tin splint.

Open Joint, Infected.

Open so as to irrigate and drain thoroughly. Bandage and dress with sterile gauze daily, after thorough irrigation with antiseptic fluid, as above. Fixation by splint, if possible. (Bier's hyperemia.) Repeated blisters in large animals may aid. Recovery only occurs with stiffness, or anchylosis, in most cases. Treatment in large animals of open, infected joints having much motion is not usually profitable. Laxative diet—H. and C., mashes, gruels, roots and green food. Dogs, gruels and milk, during acute stage.

OPHTHALMIA. (PERIODIC IN HORSES.)

Confine in dark quarters. Foment eye with hot boric acid (2 per cent.) solution for one-half hour at time, thrice daily. Drop 1 per cent. solution of atropine sulphate in eye four to six times daily. Internally, give physic ball, and sweet spirit of nitre and Sodium salicylate (3ii), thrice daily, and sloppy or green food. Iron and gentian during convalescence.

OPHTHALMIA, SIMPLE. See *Conjunctivitis.*

ORCHITIS OR EPIDIDYMO-ORCHITIS.

Seen in males owing to infections, trauma and tuberculosis.

Support and compress testicle by thick pad and bandage. In acute stage, apply ice-bag to testicle, or hot flaxseed poultices, or lead and opium lotion, or antiphlogistine in a thick coating. Give smart purge and restrict diet to soft food. After acute symptoms subside, touch scrotum lightly in 10 or 12 points with Paquelin cautery every few days and cover with compress of cotton and bandage. Also, to aid resolution, ointments of guaiacol (10 per cent.), or ichthyol (20 per cent.), or mercury may be rubbed in daily. Aspiration of fluid in tunica vaginalis advisable if done aseptically. In hematoma resulting in abscess, incise tunica vaginalis and stitch it to edge of skin incision; wipe out with pure phenol and drain sac. Tuberculous form associated with tuberculosis of kidneys, bladder and prostate (examine per rectum); if only testicle affected, castrate.

OSTEOMALACIA.

In enzoötic cases treatment is unavailing. Treatment must be undertaken early. Food from other localities best. Beef meal, peas, beans, oats, bran, linseed or cotton seed meal, green clover or alfalfa are among the best foods. Change water and pasture. Apply phosphatic fertilizers on pastures or meadows. Mix equally bone meal and precipitated lime phosphate, give C. ʒi; Sh. and Sw., ʒi-ii. To this add equal parts ferrous sulphate and nux vomica; and give cattle, of the latter mixture, 3ii; Sh. and Sw. gr.xx on feed twice daily (Moussu). Adrenalin.

OSTITIS. See *Spavin, Ring Bone.*

Sometimes tuberculous. In acute stage, rest of part and cold application, as cold swab or continuous irrigation, or ice bag. Physic, soft and restricted diet. In subacute and chronic stages, firing, blistering and rest.

OTORRHEA (IN DOGS). CANKER OF THE EAR. OTITIS EXTERNA.

In the acute stage, with much pain, give frequent and long-continued injections of hot solution of saturated boric acid, or 3 per cent. carbolic, or 1-8,000 corrosive sublimate. Use fountain syringe and avoid any forcible injection, allowing water to flow in slowly. Carbolic solution most anesthetic. Dry out canal after syringing and blow in dry pure boric acid. It is well to keep loose absorbent cotton plug in ear during treatment. If there is much swelling of the canal, scarify it. In the acute stage, give two to three co. cathartic pills. Diet of milk, broths and bread. When the acute stage subsides, use astringent injections, as 2 to 4 per cent. solutions of lead acetate, zinc or copper sulphate, or silver nitrate. To avoid pain of injection one may blow in a little powdered cocaine first. Diachylon ointment is also useful in chronic form, and boric acid in alco-

hol (1-20). The occurrence of granulations in the canal calls for use of stick nitrate after cocainization.

OVER-REACH, WOUND OF CORONET FROM, (IN HORSE).

Treat wound with continuous wet compress of 2 per cent. lysol for a few days, then with Peru balsam and bandage. To avoid: protect coronet with pad, and rasp off toes of hind feet, setting shoes back and rounding off toes of hind shoes.

OXYURIDES. See *Parasites.*

PALPITATION. See *Nervous Palpitation of Heart.*

PARALYSIS.

1. Hemiplegia, one-sided paralysis. Rare, due to apoplexy, cerebral thrombosis or embolism, tumor, fracture of skull, abscess, parasites, etc. Attend to bladder and rectum, change position of patient and supply good bedding. Later use electricity, and administer potassium iodide and strychnine. Treatment generally inadvisable, as recovery is protracted and partial.

2. Paraplegia or paralysis of the posterior extremities. Treatment depends upon the cause. Thus spinal inflammation (meningitis), fracture, hemorrhage, tumor, may induce it.

In Dogs, obstinate constipation, worms, indigestion, abnormal dentition, nephritis, cystitis, lumbago and heart disease (disturbed spinal circulation or thrombosis of the femoral arteries), occasion paraplegia. Make a thorough physical examination to eliminate heart disease, lumbago, nephritis and cystitis. In teething, lance the gums if inflamed. Usually, thorough evacuation of the bowels by castor oil and enema or manual removal of feces, and light diet of broth, will lead to a cure, when constipation is a cause. If there is vomiting, give 2-3 co. cathartic pills or calomel, cerium and bismuth by the mouth, and use enemata and manual removal of feces.

In the Horse, paraplegia occurs sometimes transiently during colic, and in mares in heat. There is also an infectious enzoötic form. Paraplegia in the horse is often mistaken for hemoglobinuria. Treat causative disease.

In Cattle, paraplegia is seen in impaction of the rumen and parturient apoplexy. (See *Indigestion* and *Apoplexy, Parturient.*) In general, evacuate the rectum and bladder and apply hot fomentations and sinapisms to loins, and later give strychnine and blister loins (unless there is a nephritis), and potassium iodide.

3. Local Paralysis due to a neuritis, from blows, pressure, injuries, cold, or central lesion. Commonest form of paralysis in the horse. Paralysis of the facial, trigeminus, radial, crural, tibial, obturator, etc., not infrequent, and recovery commonly occurs. Treatment—Remove sources of pressure or irritation, as halter in facial paralysis. Use preferably galvanic current from the onset of paralysis over the nerve root and paralyzed area, or faradic current, if it causes contraction of muscles and is not too painful. Also apply sinapisms or capsicum, or light applications of thermocautery over the course of the affected nerve. In chronic stage, employ massage with a liniment, hot and cold douches, alternately; electricity, as above, and strychnine under the skin in large doses.

PARASITES, INTESTINAL.

Order, Cestoda. Family, Taeniae or Tape Worms.

Of the Dog—Genus Taenia; species: T. cucumerina, T. marginata, serrata, coenurus, echinococcus and serialis.

Sheep—T. expansa, alba, and fimbriata in West. U. S.

Cattle—T. expansa, alba, and denticulata.

Horses—T. perfoliata, plicata and mamillana.

Poultry—T. infundibuliformis and 19 other species.

Treatment—Withhold all food for 24 hours, give anthelmintic, purge following it, and repeat dose within a few days if ineffective. Isolate the infected, burn feces and taeniae, avoid infected pastures, or disinfect same, and prevent animals from eating raw entrails of other animals.

Special Treatment.—Dogs—Oleoresin of male fern or areca nut in capsules, and follow by compound cathartic pills. Enemata to remove the worm. If the head of the worm is not removed, repeat the treatment in three days. Also oil of turpentine, pelletierine, pomegranate, kousso, naphthol and ether are used as taeniacides.

Sheep—Give areca nut (ʒi-ii) on food to lambs and repeat in three days if not effective. For T. fimbriata, give sheep thymol (ʒss-iiss) suspended in milk and repeat on succeeding days if ineffective.

Cattle—Tartar emetic (ʒiss-iiss), or arsenous acid (gr. xv), once daily for two or three days and follow with 1 lb. of Glauber's salts.

Horses—Treat same as for round worms.

Poultry—Areca nut in pills with butter (gr. xxx) and repeat in three days.

Class—Nemathelminthes, Round Worms. Order—Nematoda. Family—Ascaridae. Genus—Ascaris.

In the Horse and Ass—A. megalocephala. Give tartar emetic (ʒii-iv) in a physic ball of aloes. Oil of turpentine (℥iv) with oleoresin of aspidium (℥i) in pint of linseed oil; or, santonin (ʒiv) in oil, or calomel (ʒi) with santonin in ball. Follow this treatment with course of iron and nux vomica on feed thrice daily for weeks.

Dog—A. marginata; Cat—A. mystax. Santonin in castor oil or in pill with calomel; or areca nut in capsules or fluidextract.

Poultry—Hens, areca nut (gr. 45); pigeons (gr. xv); in pills with butter every third day. Other remedies include: Arsenic, creolin, naphthol, ether, copper sulphate, tannic acid, kamala, tobacco.

Genus—Oxyuris, Whip, Thread or Pin Worm.

Horse—O. curvula, mastigodes, vivipara. Enemata of strong solutions of common salt, of quassia, or of lime water after flushing bowel with soap and water. Also give internal treatment as for round worms (see above). Tobacco, ether and kamala are also remedies.

Dog—O. vermicularis. Treat as for thread worms in the horse.

Family—S. Strongylidae. Genus—Strongylus.

Horse—S. armatus and tetracanthus. Oil of turpentine, as recommended for round worms, or thymol (H. ʒii; Foals, ʒi), in ball coated with keratin, for five mornings, followed at end of treatment by aloes ball.

Dog—S. (or Uncinaria) trigonocephalus. Hookworm disease, Uncinaria-

sis. Thymol given hourly for three doses (gr. v-xx), preceded by 24 hours of starvation and followed by 3 compound cathartic pills. Or oleoresin of aspidium (ℳxv-3i), after 24 hours, fast, and repeated in one hour and followed in 12 hours by dose of castor oil.

Strongylidae in Cattle, Sheep, Lambs and Goats. Several different species. Isolate sick, destroy feces and litter by fire; isolate sick and disinfect infested pastures, as below, for preventive measures. Internally, oil of turpentine (℥iv), to cattle. To sheep; thymol (lambs), 3ss; Sheep, (3i-iiss).

Strongylosis in Sheep—Several species occur in abomasum, and, with tape worm, in bowels and feces. Prophylaxis: isolate sick, disinfect pastures with copperas (80 lbs. to acre in 10 per cent. solution); generous diet with plenty of salt. Give internally, on bran, areca nut (gr. 100), with arsenous acid (gr. ii), once daily for five or six doses.

S. micrurus and filaria. See *Verminous Bronchitis, Hoose* or *Husk.*

Gapes in Poultry and Birds, due to Strongulus (or Syngamus) trachealis. Oil of turpentine on feather in trachea; or tracheotomy. Inject a few drops of turpentine or ether into trachea. Inject a 5 per cent. solution of sodium salicylate intratracheally. Clean thoroughly and disinfect premises and utensils, and isolate.

PAROTITIS.

Secondary to various infections as strangles, pharyngitis; idiopathic; traumatic; and actinomycosic. Also due to salivary calculus. In acute inflammations, treat as recommended under Glandular Enlargements. In chronic, idiopathic, massage with turpentine liniment and give pilocarpine internally.

PARTURIENT APOPLEXY, PARALYSIS, OR MAMMARY TOXEMIA. See *Apoplexy.*

PARTURIENT FEVER. See *Puerperal Fever.*

PATELLA, DISLOCATION OF. (In Horses and Cattle; Foals and Calves.)

Reduce by pulling the leg forward and upward toward the elbow of the same side, with side line about neck and attached to fetlock of dislocated limb, while the operator pushes the patella into position. To prevent recurrence, the limb is kept in a less degree of this position for several hours and a smart fly blister is at once applied to the patella region. Prevent the animal from lying down by tying up head. In the horse, apply shoe with high and projecting toe for three weeks to avoid recurrence.

PERICARDITIS, ACUTE.

In Horses and Dogs, from acute infections and trauma. In Cattle and Goats, from swallowing sharp bodies which penetrate the pericardium. The treatment of the latter form is unsuccessful. At the onset, bind an ice bag over the heart and give morphine and atropine under the skin to quiet the heart. For same purpose, with fever, also prescribe aconite every two hours till frequency of pulse is decreased. As the pulse begins to weaken with progress of the disease, administer strychnine with whiskey

and aromatic spirits of ammonia and digitalis. With large effusion and much dyspnea and cyanosis, puncture pericardial sac. Incision over anterior border of 5th or 6th rib, four inches above lowest point on the breast, and wall punctured with trocar and canula. Apply fly blister over the cardiac area, and give potassium iodide internally to aid absorption of exudate. Absolute rest and digestible, laxative diet.

PERITONITIS, ACUTE AND CHRONIC.

Acute form—In all animals; generally secondary to some local inflammation, injury, as operation for hernia and castration, or lesion in the belly, as perforation of stomach or intestines, or pelvis. Parturient sepsis is a frequent cause. Treatment must be chiefly directed to primary cause. In dogs, the treatment should be laparotomy, to remove the cause, and drain, if need be. Medically, use opium heroically to quiet pain and peristalsis and enable nature to wall off infection with protective barrier of lymph. Withhold all food by mouth for week or more. Move bowels by enemata and give normal saline and food per rectum. Apply externally hot turpentine stupes, frequently renewed. Tympanites relieved by turpentine or asafetida, per rectum.

Chronic form—Treatment depends on cause, as inflammation of abdominal and pelvic viscera, tuberculosis, new growths. Ascites is often present (see *Dropsy*). Repeated blistering in small areas, and the use of tinc. ferric chloride with oil of juniper and sweet spirit of nitre—in combination—are of service in ascites. If unsuccessful, potassium iodide may be tried. In dry peritonitis, with formation of adhesions, medical treatment is unavailing.

PHARYNGITIS, ACUTE.

Occurs in Horses, Dogs, Pigs; less often in Cattle and Cats; rare in Sheep and Birds, except pseudo-membranous form. In enzoötic type, isolate patient. Good ventilation and housing; liquid or soft diet. Gruels, cooked roots, mashes, milk and green food for larger animals. Milk, gruels and soups for smaller patients. Drenches are dangerous in leading to foreign body pneumonia. Tincture of aconite hourly is useful till fever is reduced. In large animals, an electuary of kermes mineral and potassium chlorate (each 3ii in dose) is beneficial. Externally, applications of ice, hot poultices, stimulating liniments and blisters are of advantage. A wet compress covered with oil silk and bandage; or equal parts of camphor liniment and oil of turpentine rubbed in and applied on cloth, wet with same, are useful in less urgent cases. Antiphlogistine spread on hot and thick, after shaving skin, and renewed each 12 hours, is also beneficial. When abscess of glands threatens, frequent hot poulticing or application of a fly blister are in order. Relieve constipation by carron oil or artificial Carlsbad salts in doses of a few ounces on the food, and by enemata. Inhalations of 2 per cent. carbolic acid are efficacious, with cleansing and greasing of nostrils with vaseline. Abscess about the pharynx calls for incision of skin and exploration with director or fingers. Severe dyspnea demands immediate tracheotomy. In dogs, silver nitrate solution (10 per cent.) may be painted on throat, or m.v of tinc. ferri chloride may be given in one-half dram of glycerine every 2 hours for effect on throat. In

swine, apply a good fly blister from ear to ear and give veratrum or ipecac (of either, gr. xxx) on food to cause emesis and avert suffocation.

PHLEBITIS.

Due to infection following injury and operation. If diffuse it is incurable. Excise thrombotic portion of infected vein. Open abscess. Give a purge. Apply warm covering, secure rest of part. Apply Credés ointment.

PHRENITIS. See *Encephalitis.*

PHTHEIRIASIS. See *Lice.*

PICA. See *Depraved Appetite.*

PILES. HEMORRHOIDS (IN DOGS).

Keep bowels loose with equal parts of sulphur and compound licorice powder (3ss-i in capsules), or with two parts of sulphur and one of potassium bitartrate (3ss in capsules). Apply externally fluidextract of hamamelis, and inject some into the rectum. With much itching and pain: acidi gallici, gr.x; orthoformi, gr.x; extr. opii, gr.iv; extr. belladonnae, gr.iv; unguent. ad. 3iv; apply externally. If aggravated and persistent, give an anesthetic; stretch sphincter ani until it is paralyzed; clamp base of piles and burn off pile down to clamp with dull red thermocautery. Lock bowels for three days with opium. Then give injection of sweet oil and castor oil, or two or three compound cathartic pills.

PIROPLASMOSIS. See TEXAS FEVER.

PLEURO-PNEUMONIA OF CATTLE.

Destroy patients and those exposed. Slightly diseased are fit for beef. Premises cleaned and disinfected.

PLEURITIS AND EMPYEMA. PLEURISY.

Venesection with much pain and dyspnea. Fever and pain are relieved by phenacetin. Also by the application of mustard paste and hot blankets with rubber covering to the chest. Instead of phenacetin, we may give —to relieve pain and dyspnea—laudanum, ℥ii, in a pint of linseed oil to the horse; or morphine subcutaneously. With effusion, administer calomel, and also a combination of fluidextract of digitalis (3i), oil of juniper (3i), and potassium acetate (℥i) in water thrice daily to horses; to dogs, powd. squills and digitalis (āā gr. i), in pill with calomel (gr. ss), three times daily. Use wet compress about chest continuously, and applications of mustard occasionally. Give dry diet with water reduced to minimum. With large or persistent effusion, puncture the chest. In the horse, in the 8th and 9th intercostal spaces at the anterior margin of the rib and near the lower border of the lung, shave hair and use strict asepsis. After puncture, or in the later stages, employ potassium iodide, and give tinc. ferric chloride with gentian or nux vomica on the feed. Also give to larger animals nourishing diet with milk, eggs, and whiskey; to dogs —milk, bovinine and meat juice. In Empyema or Purulent Pleurisy, the chest wall must be incised and often a portion of two or more ribs resected; all adhesions to pleurae broken under partial anesthesia; and wound closed, save for drainage. Irrigation of the chest is not desirable except in case of fetid discharge.

Pneumonia, Croupous, and Broncho-Pneumonia.

At the onset in rare cases with great dyspnea and full, bounding pulse, venesection. Tincture of aconite in repeated doses every two hours, is more often useful in the beginning, to reduce the frequency of the pulse, except in influenza and asthenic conditions. An abundance of fresh cold air to stimulate the respiratory centers is of great import. In the horse, bandage the legs after rubbing mustard paste on them. For large animals, the diet should include hay, grain, roots, mashes, and, if animals do not eat well, eggs and milk; for dogs—milk, bovinine, broths, meat juice and a little meat. In the stage of hepatization, high fever (104.5 deg. F.) phenacetin (3iii) with caffeine (3i) may be given to horses in a single dose. Usually, however, cold enemata, cold air, and cold compresses on the chest, changed frequently, will be safer and more efficient. Weakness of the pulse calls for digitalis, strychnine, camphor, ammonium carbonate, singly, in alternation or combination, and repeated every few hours. The action of the kidneys is favored by spirit of nitrous ether. Keep the bowels active by enemata or with oil by the mouth. With the approach of crisis, stimulants are especially indicated, but should not be used until weakening of the pulse demands them. With overloading of the right heart and jugular pulse, employ venesection. During resolution administer expectorants, as ammonium chloride and carbonate in combination, particularly in broncho-pneumonia, and in this disease nutritious feeding is urgently demanded. In delayed resolution, give potassium iodide twice daily. In convalescence, appetite and digestion are stimulated by whiskey with tinc. of gentian and nux vomica.

Poisoning.

See Table of Antidotes. Use of stomach tube most effective. Emetics in dogs, cats and swine—mustard, zinc sulphate, apomorphine. Stimulants, as strychnine, camphor.

Poll Evil. See *Abscess* and *Fistula.*

Polyuria. See *Diabetes Insipidus.*

Post-Partum Hemorrhage. See *Hemorrhage.*

Post-Partum Paralysis. See *Apoplexy, Parturient.*

Prolapse of Rectum (In Cattle and Swine).

If slight, of mucous membrane alone, apply ice cold water, and astringents —as fluidextract of hamamelis—and replace bowel, after washing and greasing it, and raising the hind quarters, or, if impossible to reduce, apply actual cautery to prolapse in lines radiating from its circumference to the center, and burn through the sphincter in two places to aid its contraction after return of bowel. Introduce morphine suppository, or give it subcutaneously to prevent straining. If all coats of bowel are prolapsed, as happens in large prolapses, return bowel if possible, and then apply cautery in lines parallel to long axis of the bowel—just within the anus—to cause contraction there and prevent prolapse. Then apply pad over anus, and give opium. In severe (old or gangrenous) prolapse of great size, one must empty lower bowel by enema, push back any loop of small

intestine in the prolapsed portion and amputate the prolapsed portion performing an end to end anastomosis between the two ends of the bowels To prevent escape of the upper segment of bowel back into the belly, the two layers of bowel should be fixed by two or three silk sutures placed just outside the anus, before amputating.

Prolapse of Uterus or Vagina.

After cleansing and replacing parts, prevent recurrence of prolapse by the use of opium, as above; elevation of hind quarters; and by truss; West's vulval clamp; or closure of the vulva by wire sutures of the quilled type.

Prostatitis (Occasional in All Entire Males).

Occurs from extension from urethritis and cystitis, and from frequent copulation or masturbation. Rarely diagnosed. The symptoms suggest cystitis with frequent, intermittent and painful micturition; and also rectal trouble with rubbing of the anus against objects. Examination shows enlarged and painful swelling about the neck of the bladder. Treatment—Frequent hot rectal injections through double tube to allow of return flow; smart cathartic and diet of gruels, mashes or milk; entire rest. Internally, give a mixture of spirit of nitrous ether, potassium acetate and tinc. of belladonna in full dose thrice daily. Administer morphine in suppository, or subcutaneously with much pain and straining. If swelling of prostrate blocks urethra, pass a catheter. Abscess opened, not through rectum, but via perineum by careful dissection with catheter in bladder and finger in rectum as guides.

Pruritis. Itching.

Attacks Horses and Dogs and other animals independent of any skin eruption. First endeavor to remove or treat the cause. Hepatic or digestive trouble, constipation, piles, fissure and worms cause pruritus ani; pregnancy leads to pruritus vulvae, diabetes, exposure to cold and heat, nervous debility. In general itching—baths—sodium bicarb. (lb. 1-2 to 30 galls.), or sponging with vinegar. Local itching: Acid. carbol., ʒi; liq. potass., ʒi; ol. lini, ℥i. M. Sig. Use externally. Where there is danger of poisoning from licking or absorption, use liq. picis alkalinus (1-32), or hydrogen dioxide pure. All antiseptics appear to be antipruritics. In pruritis of anus or vulva, apply hot fomentations, dry by sopping gently with soft cloth, and dust on powdered starch. Also, saturated boric acid solution or silver nitrate in spirit of nitrous ether (3 per cent.), are efficient in these troubles. In debility, give iron, arsenic, and nux vomica. Other agents relieving itching are: Carbolic acid, hamamelis, chloral, alcohol, prussic acid, corrosive sublimate, tobacco, cocaine, salicylic acid, potassium bicarbonate, tar, oil of tar, oil of cade, menthol, lime water, alum, yellow wash, black wash, thymol.

Psoas Muscle Strain in Horses and Dogs.

Complete rest and the application of hot blankets about the loins and body with waterproof covering and dry blanket outside, frequently renewed. Give morphine suppository to dogs; laudanum, ℥iv in boiled starch solution;

to horses, per rectum. Use slings in case of strain of both muscles in horses.

Psoriasis. See *Eczema, Scaly or Squamous Mallenders.*

True psoriasis is unknown in veterinary practice.

Ptyalism. Salivation.

To combat the symptoms, give belladonna or atropine, or alum.

Puerperal Fever, Parturient Fever, Parturient Septicemia, Septic Metritis.

Infection following labor is treated by removing local sources, as retained membranes and blood clots; by repairing lacerations; and by irrigating the vagina and uterus twice daily with 2 per cent. lysol solution, after washing the external genitals with the same and lowering the hind quarters. Abrasions should be dusted with dry boric acid. Keep the bowels loose with salts in cows; castor oil in bitches; linseed oil in mares. Give ergot thrice daily to contract the womb. Administer large doses of alcohol (℥vi large patients), with nourishing diet of grains, milk, eggs and (for small patients) beef juice and bovinine. Strychnine in full doses is also indicated. Enemata of normal saline solution (sodium chloride, ℥i-Oi), in large amounts, so as to be retained, are of much value. Raise the receptacle holding the enema but a short distance above the patient so as to allow it to flow slowly. Try injection of a mixed vaccine. Prophylaxis: Isolation of animals about to calve or threatened with abortion. Treat as contagious disease. Avoidance of same utensils, sponges, attendants, food and water for sick and well. Disinfection of premises. Quarantine of patient till all discharge stops.

Pulmonary Congestion and Edema.

With severe dyspnea, venesection is the most effective measure. Externally, apply turpentine stupes or mustard paste and hot blankets to chest, frequently renewed. Also give a powerful hydragogue cathartic. In passive congestion due to heart disease or weakness, give digitalis, strychnine and other heart stimulants.

Pumiced Foot in Horses.

Weakness and convexity of the sole as sequel to laminitis. Apply blister to coronet and wide bar shoe, leather and oakum packing with tar.

Punctured Foot in Horses.

Remove shoes and pare away horn till the bottom of the puncture is exposed. If this treatment has not been applied at time of puncture and inflammation and pus has formed, expose suppurating area and then employ bran and flaxseed poultice mixed with 3 per cent. lysol or creolin solution for few days. Later, dress with Peru balsam and aseptic gauze, pad of oakum and bandage.

Purpura Hemorrhagica in the Horse.

Employ remedies increasing the coagulability of the blood—give fresh horse serum (℥ii) subcutaneously, calcium chloride and gelatine by the mouth or rectum. Also turpentine thrice daily, to avert hemorrhages. If turpentine unsuccessful, try adrenalin chloride solution given intra-

muscularly. When purpura follows infections, one may use collargol, 1-180, intravenously or per rectum. Many favorable reports of it have been made. Also, with streptococcus infection, antistreptococcic serum has given good results (10-50 c. c.), and the dose of this or of collargol may be repeated in 12 hours if improvement is slow. Good hygiene and food are of chief importance. Supply an airy, light, dry, warm box stall; a ration of oats, bran, roots, green fodder; and milk and eggs, if there is anorexia. Only mild laxatives, as linseed oil, are indicated. During convalescence, a powder of arsenous acid (gr. iii), ferrous sulphate (3i), with nux vomica (3i), may be given thrice daily on the food. Swelling about the nostrils may be reduced by constant bathing in cold water. Sores and ulcers demand treatment (see *Decubitus*). Tracheotomy is demanded for severe dyspnea. No harness of any sort should be permitted. Skin swellings are best overcome by the remedies preventing hemorrhage and increasing the coagulability of the blood. Incisions and local applications are generally harmful or unavailing.

PYEMIA. See *Septicemia.*

QUARTER EVIL. See *Black Quarter.*

QUITTOR. (IN THE HORSE.)

Fistula of the coronet. Remove shoes. A bar shoe may be needed if the foot is broken down. If there is pus in the sole, make counter-opening here. Open up sinus to the bottom with knife or actual cautery. The latter is best in destroying pyogenic membrane of the fistula. Remove necrotic tissue. Give mixed vaccine. Irrigate wound with 1-1,000 corrosive sublimate and apply aseptic gauze and jute, wet with corrosive solution, and bandage. Keep this wet antiseptic poultice on for several days, or a week, till acute inflammation subsides. Inject fistula occasionally with carbolic acid in glycerine (1-16). Apply dry aseptic dressing after the wet antiseptic poulticing. Repair of the horn hastened by fly blister to coronet.

RABIES IN ANIMALS. HYDROPHOBIA IN MAN. (See *Bites.*)

When persons or animals are bitten by a dog, supposedly rabid, a diagnosis is imperative. An animal suspected of rabies should be kept caged for inspection. Death occurs invariably within 4 to 30 days in rabies. If suspected dog runs away, dies, or is killed inside of 10 days Pasteur treatment advisable. If suspected rabid animal alive and in good health, after 10 days, rabies is improbable. If there is any doubt about the diagnosis, microscopical examination of the brain—for Negri's bodies in Ammon's horn (Hippocampus Major) and changes in the plexiform ganglion of the vagus—by a trained pathologist will determine the diagnosis. Specimen for pathologist should be head and neck above 3rd cervical vertebra on ice, or brain with upper part of cord in glycerin.

Otherwise, grind small amount of fresh cerebellum with twice weight of normal salt solution. Drill hole through frontal bone of guinea pig aseptically, little to one side of middle line, to dura. Use cocaine. Inject 10 drops of brain emulsion through dura with subcut. syringe.

Average incubation, 14 days, but animal must be kept 100 days to prove test negative.

All persons bitten by rabid dogs should at once be sent to a Pasteur Institute for Pasteur treatment, or virus may now be procured from Pasteur institutes, and makers of biological products for home treatment, if the history of case, duration and location of bite are given. For immediate treatment of bites of rabid animals, See *Bites*. Pasteur treatment is successful in preventing hydrophobia in 99 per cent. of persons having recent rabid infection. If clinical history and autopsy are suggestive of rabies, it is unwise for bitten persons to await results of inoculation experiments before undertaking Pasteur treatment. Prophylaxis: When a case of rabies develops all dogs within a radius of twenty miles should be muzzled for six months. Animals bitten by rabid dogs should at once be killed.

RHEUMATISM, ACUTE ARTICULAR. (In Cattle, Dogs, Horses, Pigs and Goats.) See also *Arthritis, Infectious.*

Give sodium salicylate with an equal amount of sodium bicarbonate in solution. If the salicylates cause vomiting in dogs, administer salol and phenacetin in capsules thrice daily. To the affected joints, apply cloths wet in pure methyl salicylate, or cloths soaked in a hot, saturated solution of Epsom salts, baking soda, and covered with waterproof and bandage. Inject joints with formalin and glycerin. In the later, or subacute stages, prescribe equal parts of sodium salicylate and iodide three times daily. Iodine ointment rubbed on the joints, or firing and blistering, are most effective in chronically enlarged and stiff joints. Rest, and liquid diet are indicated at the onset. In the later period, cod liver oil, quinine, iron, arsenic and strychnine with generous feeding, are required. For complications, as pleuritis, endocarditis, see these titles.

RHEUMATISM, MUSCULAR. See *Muscular Rheumatism.*

RICKETS. RACHITIS.

In the case of sucklings improve the mother's food in nitrogen, fat and salts. Give the mother cottonseed or linseed meal, or beef-meal, with rich ration of grain. Or the suckling may be weaned and receive—if herbivorous—oatmeal gruel of milk and a tablespoonful of linseed meal daily; cod liver oil; raw eggs and beef meal. Carnivora may be given milk, strong broths, gruels with milk, juice squeezed from rare beef, bovinine, cod liver oil. With anemia, syrup of ferrous iodide (foals and calves, m.xv; puppies, m.ii 3v). Phosphorus and phosphates are bone foods. Prescribe syr. of calcium lactophosphate, or glycerophosphates, or phosphorated oil (foals and calves, 3i; puppies, m.ss to m. i). General care and hygiene are of chief importance. These include grooming, cleanliness, warm, dry quarters, and fresh, country air. Pigs must be removed from dark, unhealthy styes.

RINGBONE IN THE HORSE.

Either a periarthritis or osteoarthritis of the pastern bones or os pedis, and in the first involving the external, and in the second case, the articular surfaces of the bone. When in fore limb, apply a thin-heeled bar-shoe; when in hind limb, a high-heeled shoe, to favor the natural shifting of

weight attempted by the patient. When the animal is in the stable, place a wet swab about the pastern, only work on soft ground, if possible. In acute cases, with lameness and heat in the part, apply cold swabs and enforce rest; follow by firing and blistering to secure anchylosis, if lameness persists. If this is unsuccessful, perform neurectomy.

RINGWORM. (TRICOPHYTOSIS. TINEA OR HERPES TONSURANS.)

Attacks Cattle, Dogs, Horses, Pigs, Sheep, Goats, Cats and Poultry.

Horse. Trichophytic ringworm, caused by *Trichophyton mentagrophytes, T. flavum, T. equinum, T. verrucosum;* and Microsporous ringworm, by *Microsporum Audouini.*

Cattle. Ringworm always a Trichophytosis and due to *T. mentagrophytes.*

Dog. Four varieties of ringworm occur: (1) Trichophytic (*T. caninum*); (2) Microsporous (*M. Audouini var. caninum*); (3) Eidamellian (*Eidamella spinosa*); and favus (*Oospora canina*). *See* FAVUS.

The disease is transmitted from animal to man and from individual to individual of same species; rarely from one species to another among animals.

Isolate patients, and disinfect premises, harness, clothing, bedding, cleaning utensils and objects in contact with the patient. Burn hair and crusts from the skin. The disease may be spread over the body by grooming. First soak crusts in oil and remove them with green soap and water. Paint diseased area daily with tincture of iodine, or rub in ointment (1-8) of iodine crystals and goose grease once daily. Moussu recommends on cattle with localized spots, equal parts of chloral, phenol and tincture of iodine. When generalized, wash the body with green or tar soap and apply boric acid (℥ii) in alcohol (℥x) and ether (℥iiss). Salicylic acid in alcohol (1-10) may also be used over large areas without fear of poisoning from absorption or licking of the drug. Many other drugs are curative, as 10 per cent. ointment of either creolin, lysol, or tar. In small areas, ung. hydrargyri ammoniati. It is best to clip the hair about diseased patches and pull out that on the patches, if feasible.

ROARING.

In Horses; rarely in Cattle and Dogs.

Due to left-sided paralysis of the larynx, from toxemia of acute infections; also to thickening of the mucous membrane, obstructions, stenoses, and new growths in the upper air passages. Paralysis of the larynx is only relieved by denudation of mucous membrane from left ventricle or rarely from both. Temporary or false roaring is common after influenza and laryngitis and is curable by the application of a fly blister over the larynx, or better, red mercuric iodide. Give internally potassium iodide, thrice daily for some time. The local injection of strychnine into the region of the larynx once daily is said to delay the onset of paralysis. Arsenic internally may aid the action of the iodide in promoting resolution of thickened mucous membrane.

ROT IN SHEEP, DISTOMIASIS. See *Liver Rot.*

ROUP. See *Laryngitis, Diphtheria, Croup.*

SADDLE GALLS.

Avoid friction and undue pressure of badly fitting harness, and heavy cloth or felt linings. Use only harness linings of light leather. Treat at first with wet dressing of two parts of saturated boric acid solution and one part alcohol on aseptic gauze, covered with oil silk blanket and surcingle. Treat inflamed sebaceous follicles as advised for Acne (see *Acne*). Islands of necrotic tissue, or sitfasts, must be removed by the knife. To the remaining wound apply balsam of Peru and aseptic dressings, or an astringent, stimulant and antiseptic powder.

SAND CRACK. QUARTER-CRACK.

Prophylaxis:—Avoid weakening the foot by paring away sole and frog, and thus putting all the horse's weight on wall of foot. Occurs in inner quarter of fore foot; in toe of hind foot. Remove the shoes, and pare thin the edges of the fissure. Apply flaxseed and bran poultice mixed with 2 per cent. creolin, and rest, to relieve the inflammation. After the inflammation has passed, treat the crack by either removing a V-shaped piece of horn; by paring away the upper portion of crack to sensitive laminae and coronary band above, and clamping the crack below; or by grooving the wall above at right angles with the crack. All these measures tend to immobilize the edges of the crack and allow of formation of new horn. To stimulate growth of horn, also blister the coronet. Apply bar shoe, with thin heels and side clasps in fissure of toe; a three-quartered bar shoe in quarter-crack. Employ covering of wood tar on hoof continuously.

SARCOMA.

Use knife freely and try Coley's mixture of toxins of erysipelas and B. prodigiosus. At times very successful in human practice.

SATYRIASIS. See *Sexual Excitement.*

SCAB IN SHEEP.

Due to Dermodectes communis, var. ovis. Lambs and yearlings most susceptible.

Segregate and dip newly-bought sheep. Isolate sick and disinfect premises and contaminated objects. Shear sick and remove crusts with soft soap solution (1-50), aided by brush. Treatment is done with baths or dips. They are given only four hours after feeding and at body heat. Repeat dip in ten days and keep animal in bath two minutes. Dip head under once, in sulphur dip; keep mouth, nose and eyes out in poisonous (tobacco, arsenical) dips. For shorn sheep, use U. S. Bureau of Animal Industry Dip, which is cheap, safe and efficient. Flowers of sulphur, 24 lbs.; unslaked lime, 8 lbs.; water, 100 galls. Mix lime in box with water to make paste; sift on sulphur; stir all well together. Boil with 25 galls. of water for two hours or longer, till solution of chocolate-liver color and sulphur mostly disappears from surface. Settle mixture in a barrel with bunghole four inches from bottom; allow four hours for settling. Draw off only clear liquid into dipping vat and add water to make 100 galls. For animals in full fleece, use manufactured tobacco, 1 lb.; flowers of sulphur, 1 lb.; water, 5 galls. Soak tobacco 24 hours or more, on night before dipping, boil tobacco solution for a minute and allow tobacco to remain in it over

night. Mix sulphur to paste with water in a pail. Strain liquid from tobacco by pressure, and add liquid to sulphur paste and enough water to make 5 gallons. After dipping, turn sheep into clean yard. Dip healthy sheep first; then scabby ones, when a flock is attacked. There are many excellent commercial dips on the market; follow specific directions with each. Other agents include: creolin, 2 gallons; arsenic, 1.5 lbs.; iron sulphate, 10 lbs.; water, 100 gallons, etc. Good pasturing and generous feeding aid resistance against scab.

SCABIES. See *Mange*.

SCRATCHES. See *Erythema*.

SEEDY TOE IN HORSES.

Sequel to laminitis.

Remove all diseased horn and apply Peru balsam to the exposed tissues. If there is lameness, use bran and flaxseed poultice mixed with 2 per cent. lysol solution. Otherwise, blister the coronet. Apply a bar-shoe with sole pressure and keep the cavity dressed with the balsam. Frequent changing of the shoe and trimming of the foot is required to restore and keep it in normal shape.

SEPTICEMIA. PYEMIA. SAPREMIA.

In blood poisoning, with germs or their products, the treatment is chiefly surgical: the use of antiseptic poultices or other antiseptic applications to wounds; the removal of septic and dead tissue by the knife; the drainage of purulent foci, etc. Nourishing diet—reinforced by milk and eggs, beef juice, bovinine, alcohol and quinine, etc. The fresh horse serum (D. 3ii-iv. H. ℥ii-iv) given subcutaneously has great germicidal effect. Oil of turpentine may be used as a stimulant and antiseptic (H., 3i) in emulsion with milk and eggs. Calomel is useful as an antiseptic cathartic. Saline infusions are often most valuable. Collargol has also given very good results. Anti-streptococcic serum is remedial in streptococcus infection. The tinc. of ferric chloride is indicated during and succeeding an attack.

SEXUAL EXCITEMENT. NYMPHOMANIA. SATYRIASIS.

In female (nymphomania), sexual excitement depends upon various inflammatory diseases, as vaginitis, metritis and other disorders of the vagina, womb, ovary. Retained testis is a common cause in males. Over feeding, lack of exercise, and constant companionship with females favor sexual excitement in the male. Treatment consists in removing the cause, as surgery in organic lesions yielding to the knife. Secure only proper amount of coition and avoid proximity of male to opposite sex. Give hard work, low diet, and full doses of potassium bromide. If trouble due to spinal or cerebral lesions, little can be done. As a last resource, castration of either sex or slaughter.

SHOE BALL. See *Capped Elbow*.

SHOULDER LAMENESS (IN THE HORSE).

Sprain of the spinati and, to a less extent of the teres muscles, with swelling, followed by atrophy of these parts. In the acute stage, apply constant, hot fomentations to the shoulder muscles, and secure absolute

rest. When local tenderness and swelling abate, apply cantharides blister to muscle, and later exercise at pasture may lead to recovery. Local intramuscular injections of veratrine may be of service in atrophy of the muscles. Occasional blistering is of most service. Avoid ploughing to prevent return of trouble.

SICK, DESTRUCTION OF.

Strychnine, chloroform, prussic acid.

SIDE BONE IN THE HORSE. OSSIFICATION ON THE LATERAL CARTILAGES.

Rest and cold swab about foot with heat and lameness. In other cases, firing and blistering are indicated, and the application of a bar-shoe. The effects of concussion may be somewhat averted by making a groove below the cartilage in the wall of the foot with a knife or firing iron. Neurectomy in otherwise sound limbs.

SITFAST. See *Saddle Galls.*

SLEEPY STAGGERS. See *Encephalitis.*

SNAKE BITE. See *Bites.*

SORE THROAT. See *Pharyngitis.*

SORES. See *Wounds.*

SORE SHINS. See *Periostitis* and *Ostitis.*

SPASM OF THE DIAPHRAGM (IN THE HORSE). THUMPS.

Give spirit of chloroform or compound spirit of ether. If persistent try morphine under the skin; also inhalations of amyl nitrate. Apply hot applications over the diaphragm; pull out the tongue. If breathing becomes difficult, use venesection to avert pulmonary apoplexy.

SPASMS. See *Convulsions, Eclampsia, Epilepsy, Chorea, Tetanus, Colic, Asthma, Thumps, Etc.*

SPAVIN, BOG. See *Bog Spavin.*

SPAVIN, BONE (IN THE HORSE).

In acute cases, rest and the application of a compress kept constantly wet with cold water. This may be followed by firing and blistering—to secure anchylosis—in young animals. The use of a high-heeled shoe may benefit many cases. Other operations which may relieve the lameness are cunean tenotomy and anterior and posterior tibial neurectomy.

SPLINT.

Apply cold compresses, when the animal is in the stable, and later the ointment of red mercuric iodide, every other day till blistering occurs. When this is not curative, fire in points and blister with cantharides, followed by rest. In very acute cases, incise the periosteum at the onset.

SPEEDY CUT (IN THE HORSE).

Apply antiseptic gauze, wet with 2 per cent. lysol and covered with rubber or oil silk, and bandage, to injury on knee. Otherwise treat as for *Wounds.* Employ a boot to save knee from being struck. To prevent,

pare away inner wall of striking foot and use accurately fitting three-quarter shoes. Shoe once in three weeks. Avoid too rapid work.

SPINAL INFLAMMATION. SPINAL PACHY- AND LEPTO-MENINGITIS, MYELITIS.

Traumatism, tuberculosis, septicemia, pyemia, distemper, strangles and growths are etiological factors. Treatment depends on etiology to some extent. In acute spinal meningitis, treat as for cerebro-spinal meningitis, except cold should be applied to spine rather than to the head. In the later stages, blisters applied over the lumbar region—or over centers corresponding to the peripheral lesions—are indicated. Potassium iodide may be useful in aiding resolution. Tonics, as strychnine and iron, are valuable. When there is marked paraplegia, keep horses in slings and empty bowels and bladder regularly. Employ faradism and massage of paralyzed muscles. Recovery is uncertain and treatment is often economically inadvisable.

SPRAINS OR STRAINS OF MUSCLES, TENDONS OR LIGAMENTS.

Usually involve actual rupture of the fibres of these structures. At the onset, secure rest and immobilization of the part as far as possible. Take off weight by slings; apply high-heeled shoe in strain of flexor tendons of feet in horses. Apply compresses wet with hot saturated solution of Epsom salts and covered with waterproof cloth, or cold irrigations and Priessnitz poultice at night, with rubber bandaging to prevent exudation and swelling of the part. After the acute symptoms abate, alternate hot and cold applications of water—to stimulate circulation—and begin soon with massage and movement of the part and gradually increasing exercise. Keep the part bandaged if possible when not applying treatment. Various liniments may be used to aid massage, as chloroform or turpentine liniment. Firing and blistering, or simply blistering, and turning out animal to pasture, may secure recovery. Subsequent cicatrization with contraction of tendons and ligaments can not be prevented except in part by early movement of the injured limb. Tenotomy may be used for contraction. Fibrolysin, may be injected for induration. Neurectomy is occasionally advisable for lameness.

STERILITY (SEXUAL). See *Barrenness* and *Impotence.*

STOMACH STAGGERS. See *Indigestion.*

STOMATITIS.

In simple stomatitis, use mel boracis (B. P.) on a swab in the mouth. The food should be liquid or soft. Give potassium chlorate internally. With ulceration, swab out mouth with 1 per cent. lysol or creolin solution several times daily and touch the ulcers with 10 per cent. silver solution, or with tinc. of iodine. To the large animals, give a few drams of Glauber's salts and saleratus on the food thrice daily. There is also an infectious pustular form of stomatitis affecting horses. The local treatment is the same as above but isolation of patients followed by disinfection are indicated. To sheep, sodium chloride and salicylate in their drinking water (in the proportion of 15 gr. each to the pint). Hydrogen dioxide is perhaps the most effective antiseptic mouth-wash, but more ex-

pensive than boric acid. Stomatitis is very prevalent in the young. Fresh air, cleanly premises and exercise must be given. Nourishing food is a requisite to recovery. Isolate the sick and avoid common use of utensils for eating or drinking. Stomatitis is a complication of infected umbilicus in calves; gangrenous tissue must be cut away and the navel swabbed with tincture of iodine and packed with iodoform and boric acid.

STRAINS. See *Sprains.*

STRANGLES IN HORSES.

Give "antistrangle vaccine or serum" as a preventive and polyvalent antistreptococcic serum as a curative agent.

Isolate the sick in roomy, airy box-stall and disinfect the vacated premises. Diet—Gruels, mashes, steamed oats, grass, roots; and milk, eggs and alcohol, if there is anorexia. A vaccine made of S. equi is a good prophylactic agent given to horses in doses of 1 to 2 c. c. Apply, and frequently renew, hot flaxseed poultices to the inflamed submaxillary gland, and open when "ripe." Syringe abscess cavity with hydrogen dioxide and dress with Peru balsam. Remove induration by a fly blister to the surrounding area. Treat complications as they arise. Tracheotomy is required for obstruction about the larynx.

STRINGHALT IN HORSES.

Several forms.

1. In some cases it is purely a functional nervous disease like chorea; treatment on this basis includes the use of bromides, improvement in general hygiene, and rest.

2. A form dependent on retraction of peroneo-phalangeus, which may be cured by peroneal tenotomy and aponeurotomy.

3. A form produced by tarsal deformative arthritis, or spavin. Treat as recommended for Spavin.

4. Patellar form. Sometimes cured by section of the tibio-patellar ligament.

STURDY. See *Coenurus Cerebralis.*

SUNSTROKE. INSOLATION. HEAT STROKE.

1. Apoplectic form, with coma and very high rectal temperature. Turn hose of cold water on the head and body and make vigorous friction of the body with ice. With injected mucosa and labored breathing, venesection. With failing pulse, inject under the skin of the horse camphor (gr.xv), with ether (3ss), and sweet oil (3ii). Also cocaine, strychnine.

2. In the form with weak pulse and prostration (without hyperpyrexia), give stimulants as above, and externally hot pack.

Prophylaxis: Head coverings; give cold water frequently and apply it to head; moderate work; avoid work in heat of day.

SURGICAL SHOCK.

Give morphine under the skin, and adrenalin intramuscularly, and apply heat externally with mustard. Inject normal salt solution into the rectum, into a vein, or under the skin. Also camphor, atropine, strychnine and tincture of digitalis given hypodermatically.

SURFEIT. See *Urticaria.*

SURRA.

Surra occurs in solipeds, dogs, rats, camels and elephants and is transmitted by inoculation by flies (Tabanidæ) into cattle, sheep, goats, buffalo, guinea pigs and rabbits. Due to Trypanosoma evansi. Appeared in imported cattle in U. S. in 1906 but was immediately eradicated. Characterized by irregular, intermittent fever, urticaria and edematous swellings on various parts of the body, catarrh of nose, eyes and vagina, with progressive emaciation, weakness and anemia. Diagnosis is made by inoculation of rabbits with blood from infected animals. The trypanosomes appear in rabbit's blood in 4 to 9 days accompanied by fever.

Prevention. Isolate suspected animals in individual fly-proof stalls and inoculate rabbits with their blood. Kill those affected. In India, where disease is indigenous, increasing doses of arsenic, or of sodium cacodylate, atoxyl, or arsenophenylglycin.

Usually fatal in horses, not in cattle which act as "carriers."

SWINE FEVER. See *Hog Cholera.*

SYNCOPE. HEART FAILURE. FAINTING. See *Cerebral Anemia.*

Keep the head low and inject under the skin pure ether. Give subcutaneously strychnine with digitalone every few hours. Also the injection of camphor is useful.

SYNOVITIS.

Rest and fixation of joint most important. Slings or the use of splints secure rest and fixation. The application of an ice and sawdust poultice, or ice bag bandaged on to the joint or constant cold irrigation, or sometimes more useful, is hot saturated solution of Epsom salts on compresses covered by waterproof protective and bandage. Compression of the joint by rubber or flannel bandage is serviceable after the more acute symptoms abate. In subacute stage, firing and blistering are to be recommended. When effusion and most of the thickening about the joint disappear, allow gentle exercise, which may be gradually increased.

See also *Open Joint,* and *Arthritis.*

TAPEWORMS. See *Parasites, Intestinal.*

TEATS, FISSURED, CRACKED.

Wash udder thoroughly with soap and water and saturated boric acid solution. Withdraw milk through sterile milking tube. Coat fissures with co. tinc. benzoin, or with solid lunar caustic. Keep teats anointed with 10 per cent, boric acid vaseline.

TEATS, OBSTRUCTED.

Concretions removed by manipulation of teat or by passing bougie, or teat siphon.

Inflammatory thickening relieved by poulticing and fomentations. It may be necessary to cut the teat with teat bistoury to relieve a stricture. Growths within the teat and warts without are removed by scissors or ligature.

TENDONS, RUPTURE OF.

Splints, slings, and treatment as for fracture. If open wound, suture the

tendon and sheath. Subcutaneous rupture unites more surely with aseptic suturing in human practice, but there is great danger of sepsis in veterinary practice.

TENOSYNOVITIS.

General treatment as for synovitis. Bier's hyperemia. Rest, fixation, applications of heat and cold, counterirritants, and finally exercise. See *Thorough-Pin.*

TETANUS.

Common to all animals; especially to Horses, Cattle and Sheep.

Therapeutic treatment with antitoxin is generally unsuccessful, but prophylaxis (before symptoms arise) is usually very effective in preventing tetanus when antitoxin is injected. In wounds of the feet, in regions where tetanus is prevalent; also in the new-born, in cows just calved and for all animals after surgical operations in regions infected by tetanus, the antitoxin preventive treatment should be employed. Immunity thus conferred lasts about a month and is without danger. Repeat these injections of antitoxin at the end of the first and third week, to prevent the intoxication caused by belated crops of tetanus bacilli. Locally, any wound likely to contain tetanus germs must be opened freely to the bottom and tincture of iodine used. In new-born lambs and calves sterilize the stump of cord after ligation with iodine. In slowly developing and chronic cases tetanus antitoxin is successful as a therapeutic agent. Bacelli's carbolic acid treatment internally is the most successful for fully developed tetanus (90 per cent. cured). Inject into muscles of the neck of horse 3i of pure phenol in 3 per cent. watery solution every two hours, for first 36 hours, and less often thereafter. To relieve spasm of jaw and elsewhere, give morphine (gr. vii-x), subcutaneously, with chloral (℥ii-iii) in boiled starch solution by rectum. Chloroform by inhalation may give temporary freedom from spasm. The use of slings, a quiet, darkened box-stall, and gentle management are desirable. The diet should be of a sloppy character—milk, gruels, and perhaps some green fodder, with water within reach at all times. Empty the bowels manually or by enema; the bladder by catheter or pressure within the rectum. Thorough disinfection of the premises after a case of tetanus is imperative.

TEXAS FEVER. See *Hemoglobinuria in Cattle.*

THICK WIND IN HORSES.

Treat as for *Broken Wind.*

THOROUGH-PIN OF THE HOCK AND KNEE.

Tenosynovitis of the perforatus tendon just at the summit of the os calcis. Usually chronic, as hydrops of the tendon sheath. In acute cases, apply a high-heeled shoe and secure rest, and apply wet compresses and flannel bandage about the lower limb and hock. In chronic cases, apply spring truss, or operate by aseptic excision or curetting of wall of the sac and free drainage, to secure obliteration of the sac and adhesion of the tendon to the tendon sheath. There is considerable danger of sepsis, however, in the operation. Aseptic aspiration of the sac and injection of tincture of iodine or of carbolic acid (m.x-xx) may produce the same

result with less danger of infection. Unless the animal is valuable, operation is inadvisable. Firing and blisters have little curative value. Hydrops or hygroma of the common tendon sheath of the perforatus and perforans at the back of the carpus. This is treated exactly as recommended for hydrops or dropsy of the perforatus tendon (thorough-pin) at the hock.

THROMBOSIS.

Of the Cerebral Arteries. See *Apoplexy.*

Of the Anterior Mesenteric Artery. See *Colic.*

Of Femoral and Axillary Arteries.

Shown by intermittent lameness and complete paresis, with loss of pulse, in affected limb. Treatment by rest for many weeks and potassium iodide thrice daily. The clot in femoral artery may be felt per rectum, and massage over it has been recommended, but is liable to cause sudden death by embolus. Swelling of the limb may be combated by bandaging.

THRUSH (IN THE MOUTH). See *Stomatitis.*

THRUSH IN FROG OF HORSE.

Keep the feet out of manure and urine by constant cleanliness of stable or by movable leather sole and calks, to prevent moisture from reaching the foot. Remove from wet yard or pasture. Dust calomel and iodoform (equal parts) on the frog and work the powder into cleft of the frog, by means of a probe, and pack with tow on top of it. Application of wood tar and tow and leather soles may be placed over this. If seen in fore feet, without apparent cause, or if there is swelling of the limbs and evidence of poor circulation, give a purge, tonics, and regular exercise.

TICKS. WOOD TICKS. IXO'DES.

Ticks are the means of transmitting Texas fever to cattle (Boophilus annulatus or Rhipicephalus annulatus), and the allied disorders—Australian tick fever and ixodic anemia of cattle—by inoculating the organisms of these diseases through their bites. In sheep, louping ill is likewise communicated by ticks (Ixodes ricinus or reduvius), which inoculate a special organism by means of their bites. The Ixodes americanus—common in dogs, cattle and man—is the most frequent in the U. S. I. reduvius attacks dogs and cattle, as well as sheep. Ticks should not be torn away from the skin, as their bodies will be severed from their heads and the latter be left in the skin. Unless buried deep in the skin, the application of butter, kerosene, oil of turpentine or benzine will cause the ticks to loose their hold. The whole tick may be removed by cutting them out with scissors, skin and all. Ked or Keb refers to Melophagus ovinus, which is not a tick, but a wingless fly attacking sheep and usually confused with ixodidae. This insect may be removed by baths, as for Scab in Sheep, and their inroads prevented by applications of kerosene. Baths or dips are also prophylactic in louping ill.

TINEA TONSURANS. See *Ringworm.*

TOOTHACHE.

In the Horse—Extraction by forceps, or by trephining and punching out the offending molar.

In the Dog—Counter-irritation of gum by tincture of iodine; filling the tooth with dental amalgam after proper removal of carious matter; lancing the gum for alveolar abscess; or extraction.

TRACHEITIS, OR TRACHEO-BRONCHITIS. See *Bronchitis.*

TREAD.

Bruise of coronet by opposite foot or by foot of another horse. Apply wet compress (3 per cent. creolin) and treat as for *Wounds.*

TREMATODA, FLUKE WORMS. See *Liver Rot.*

TRICHINOSIS.

The Trichina spiralis attacks all animals, but more often swine. Treatment is wholly preventive in destroying rats and mice, where pigs are kept, and in not feeding flesh to swine. Trichinous meat should be burned.

TUBERCULOSIS.

In order of frequency affects Cattle, Birds, Swine, Cats, Goats, Horses, Sheep and Dogs.

Most animals are infected by the bovine type of B. tuberculosis. Dogs and cats are susceptible to the human type of bacillus. Infections occur through the digestive and respiratory tracts, and extend by the lymphatics —sometimes by the blood stream (leucocytes) or by continuity—and bacteria often penetrate a part without producing lesions at the point of entry. Tuberculosis is acquired by the bacilli in the nasal and uterine discharge and feces of patients, infecting the water, fodder and dust of a barn; also through the young feeding on milk from tuberculous animals. Crowding, poor ventilation and poor nutrition favor the disease. Tuberculosis is not usually inherited, but the tendency to it is; the young are most susceptible; some six months' habitation in infected surroundings may be required for the disease to be acquired by the previously healthy.

Treatment—This is rarely advisable in animals, since it is so often unsuccessful and because the existence of the disease threatens the life of other animals, and man through diseased meat, milk, and—in the case of cats and dogs—through their sputum. An outdoor life, day and night, together with highly nutritious diet, may lead to recovery and is the most hopeful and successful form of treatment for animals, as for man. Prophylaxis is secured by an outdoor life, or one in clean, well-ventilated and uninfected stables. Milk from tuberculous animals should be boiled before it is fed to hogs or other animals. The sick should be isolated and killed, or Bang's segregation method may be used. Cows showing marked physical signs of tuberculosis should be killed—particularly of the lungs, uterus and udder. Animals reacting to tuberculin test should be isolated; their calves removed to separate farm, barn, or partitioned portion of same barn. Calves fed from mother on day of birth, thereafter on boiled milk from same, or milk from healthy cows. Two sets of employees if possible. If not, then the healthy animals should be first tended, and the overalls and shoes should be changed before tending the tuberculous. Also there must be separate utensils for the healthy and tuberculous. The healthy and sick should be separated in pasture. The healthy animals must be tuberculin tested as usual. The infected barn should be washed and cleaned and sprayed with 3% formalin, or 1-500 corrosive sublimate solution, on

the walls, floors, and feed boxes; the floors should be covered with quicklime; and the premises then disinfected with formalin or sulphur vapor. The tuberculin test must be applied to all newly-bought animals, before they are included in the herd, and the whole herd should be tuberculin-tested every 3 months until no animals react. Raw milk from tuberculous cows is unfit for food and is a means of transmitting the disease to man, especially to infants. Von Behring's Bovovaccine—of dry, living, tubercle bacilli of the human type—appears to confer immunity, for a more or less indefinite period, in cattle. It is indicated for injection into young animals, as a preventive agent, when tuberculosis is prevalent in a herd. Its value is still a matter for the future to determine.

Tympanites, Acute (in Cattle and Sheep).

Gaseous distension of the rumen is common in sudden changes of diet from dry fodder to clover or lush grass. Perform active massage of the left flank. Pass a stomach tube. To stimulate peristalsis, throw a stream of cold water against the left flank, and give compound spirit of ether, internally. With increasing distension, plunge a knife, or, better, a trocar and canula, into the most prominent part of the left flank, midway between the angle of the hip and last rib. Compress the tissues about the canula, to prevent gas and food from entering the tissues. The canula may be left in place 24 to 48 hours and the animal should receive but little food—hay and bran mash. If the rumen is impacted, see *Indigestion*.

Udder, Inflammation of. See *Mastitis*.

Ulcers.

Wounds with general tendency to break down (necrosis) and suppurate rather than to heal. These include ulcers at point of ear (dogs) and point of tail (cattle and dogs).

Ulcers in hind legs of horses, associated with swelling and general debility.

Gangrenous ulcers, carbuncle of coronet or foot rot in horses—from injury, special infection and frost bite about the coronary region.

Indolent ulcer about the coronet of old horses.

Corneal ulcers and stomatitis ulcers in dogs and other animals.

Ulcers due to carcinoma of the skin (horses and dogs); to tuberculosis, actinomycosis and glanders in horses.

Decubitus, or ulcers due to pressure in lying down.

Ulcers due to treads on coronet and to pressure of collar and saddle on the neck and withers.

Treatment—In general, the treatment consists in destroying and removing the unhealthy necrotic tissue and substituting in its place a healthy wound. For this purpose we use the actual cautery, curette, scissors, knife or caustics, as in the case of gangrenous ulcers. For less urgent cases we may apply the stick lunar caustic, tinc. iodine, phenol, or strong solutions of mercuric bichloride, formalin (10 per cent.), or zinc chloride. If there is much surrounding inflammation and tissue to be gotten rid of by sloughing, we should apply aseptic gauze soaked in 2 per cent. lysol and covered with waterproof and bandage till sloughing has proceeded and inflammation subdued. Then we may dress with Peru balsam, or stimulating and anti-

septic powder, as calomel and iodoform. For ulcers due to specific diseases see names of those diseases. Removal of cause of irritation is essential. as of foreign body or dead tissue. Rest of the part is also requisite, as bandaging or ear-cap in case of ulcer of the ear in dogs.

Umbilical Infection.

Foals, calves and lambs. Due to streptococci, staphylococci, colon bacilli, B. necrophorous, etc. Prevention. Segregate cows about to calve. Excise cord aseptically and ligate. Swab stump with tincture of iodine and cover with salicylic acid and starch (1 to 4). Clean surroundings and bedding. If navel necrotic do not ligate cord but cut away dead tissue and syringe navel sinus daily with 2 per cent. lysol solution, being careful not to force it through urachus into bladder. With persistent urachus inject saturated solution of alum and boric acid containing 2 per cent. phenol. Udder and perineum of mother kept clean so that suckling will not swallow necrophorous or colon bacilli.

A vaccine made from navel exudate will prevent if given to a new-born, and sometimes 10 c.c. of antistreptococcus serum given within 24 hours of birth will prevent when disease enzoötic. Septic arthritis often follows. Disinfect premises used for parturition before a new animal is admitted.

Urethritis in Dogs.

Associated with Balanitis very often.

At first give cathartic and light diet of milk and bread, and enforce rest. Foment frequently with hot saturated boric acid solution and inject hot 2 per cent. solution of the same into the urethra. Internally, give tinc. hyoscyamus (m.x-xx) and sweet spirit of nitre (m.xxx) with potassium citrate (gr.xv) in solution thrice daily. After subsidence of more acute symptoms, inject 1 per cent. solution of zinc sulphate and lead acetate in combination or use 5 per cent. argyrol solution; or silver nitrate solution (1-16,000 to 1-4,000). Use boiled, soft-rubber catheter, if there is urethral obstruction. Obstruction from swelling of urethra, or urethral stone, may require perineal section.

Urinary Retention and Incontinence.

If retention is due to spasm of the sphincter, as in colic, then the application of hot fomentations to the loins, morphine and atropine under the skin, or warm baths in small animals, will relieve. Pressure on the bladder through the rectum, or the use of the catheter, are most rapidly effective in horses. If retention of urine is due to stone in the ischial region or S curve of the urethra in oxen, then massage it out; do urethrotomy; or slaughter before the bladder ruptures and absorption of urine spoils the meat. In sheep with urethral stone, massage the urethra and excise the spiral filament at the end of the penis; or slaughter. In retention from phimosis, paraphimosis, and stone in the bladder, circumcision, incision of the sheath, and cystotomy are respectively indicated. Stone in the bladder in sheep and cattle may be prevented by giving sodium bicarbonate with the food and allowing water at the animal's constant disposal; and this generally is necessary in fattening. (See *Calculus.*) Retention of urine from paralysis of the detrusor muscles, in nervous disease, may be overcome by the use of strychnine and remedies combating the primary disorder.

Urinary incontinence may be caused by paralysis of the sphincter muscle of the bladder from prolonged retention of urine; or from obstruction by stones and new growths in the bladder. In paretic conditions, the administration of strychnine, alternate injections into the bladder of cold and hot water, and treatment indicated for general debility are in order.

Urticaria, Nettlerash, Surfeit, Hives.

In Horses, Cattle, Pigs and Dogs.

Due to external irritation by nettles; bites of insects, fleas and lice; chemicals, and sudden cooling of the skin. Also to irritants within the body—as products of indigestion and toxins from infections, pregnancy, rheumatism, and hemoglobinemia; and to specific foods and medicines.

Treatment—Give a purge—H., aloes; C., Epsom salts and calomel; swine, calomel; dogs, the same, or two to three compound cathartic pills. Externally, bathe with saleratus and water (℥i-Oii), or vinegar, pure or diluted. Sanitas (1 to 2) and terebene (1 to 8) in water, are also beneficial.

Uterine Inertia and Subinvolution.

Give fluidextract of ergot in full dose thrice daily for two or three weeks, and it may well be combined with a moderate dose of quinine sulphate. In subinvolution or hypertrophy of the womb following labor, the use of hot vaginal injections also aids the action of ergot in restoring a normal condition.

Vaginitis and Vulvo-Vaginitis.

Due to infection of injured parts after labor; to the action of strong injections or foreign bodies; and a third form to infection from the bull. Croupous vaginitis is sometimes seen as a variety of puerperal infection. In the acute stage, with swelling of the vulva and inflammation and discharge from the vagina, anoint the vulva with carbolized vaseline and inject sodium bicarbonate solution (℥ss-Oi) through a sterile, perforated, soft-rubber tube. If there are lacerations in the vagina, it should be irrigated with 1 per cent. lysol solution and the vagina filled with dry boric acid and packed with sterile gauze. Renew the dressings frequently. After the subsidence of the acute stage, inject zinc or copper sulphate solution (of either, ℥i-Oi) twice daily. An occasional swabbing of the vagina with freshly made 5 per cent. argyrol is also beneficial. Examine the vagina with a speculum, as a vaginal discharge may arise from the uterus.

Vaginitis, Infectious Granular of Cattle.

Cows, urinary frequency and straining, thin vaginal discharge; swelling congestion of vulva and vagina. Gray coat on vagina through which minute, red, and later translucent, follicles seen. In bulls some balanitis. Sterility abortion, nymphomania, loss of milk in cows; often sterility in bulls. May last for months.

Prevention. 1. Segregate the sick and kill cows with uterine infection. 2. Examine cattle for disease before purchase. 3. Infected bulls not permitted to serve cows. Service not allowed before 10 weeks in cows, or 8 weeks in bulls, after onset of disease. Wash penis of bulls with 1 qt. 1 per cent. lysol after service where disease prevails. 4. Daily cleanliness and use of chlorinated lime on floors, with destruction of infected utensils.

5. Wash hind quarters with soap and antiseptic solution daily. Give daily injection 2½ per cent. solution of liq. cresolis co., followed by insertion of 10 per cent. lysol ointment (3iiss) by syringe or capsule in cows, and apply 6 per cent. ointment of same to penis in bulls. Use the ointment daily for 5 days, every other day for 10 days, then every third day for a month. Clip hair of sheath in bull and syringe daily with lysol solution before using ointment. Over-strong solutions aggravate condition. Vaginitis and Anovulvitis in Cows and Heifers, with yellow, cheesy necrotic patches due to B. necrophorous and enzoötic—Segregate sick, give 2 per cent. lysol vaginal injections, clean and disinfect premises with 5% phenol solution.

VARICOSE VEINS.

Permanent dilatations of veins.

Very rare in the domestic animals. Treatment—Support by bandage. Radical cure can only be obtained by excision of the vein or double ligation, at either end of dilatation.

VARIOLA. POX OF SHEEP, CATTLE, SWINE, DOGS, BIRDS AND MONKEYS.

Caused by a protozoön Cytoryctes variolae (?), found in the skin of man (smallpox), sheep and cattle. Sheep pox is the most common and important disease—Variola Ovina. It is not readily communicable to man but occasionally to dogs, swine and goats. Variola in sheep is highly infectious and very fatal (90 per cent.). In sheep pox, slaughter of the sick and exposed animals and thorough disinfection of the infected premises are essential. Infection may last for six months in the infected premises, and for six weeks about sheep after their recovery from variola. The sheep—on recovery—should therefore be dipped in 2 per cent. creolin or lysol solution. Ovination, or inoculation of sheep with the virus of sheep pox, has been done with greatly varying mortality (from 2 to 20 per cent.). Inoculation from an already inoculated sheep, by means of the virus taken from a pustule at the tenth day, and introduced into the tail of a healthy sheep, will produce immunity without eruption. No inoculations must be made until variola breaks out in a flock, or the disease may be spread by the process. Medical treatment includes cleanliness of surroundings and bedding; warm shelter; fresh air; soft and nourishing food. The nostrils and eyes should be cleaned with saturated boric acid solution; and chalk may be put in the drinking water, if diarrhea is present.

Cow pox and horse pox appear to arise from contact of healthy animals with variolous or vaccinated persons. Cow pox therefore usually occurs in cows; occasionally in bulls, oxen and young stock. Cow pox is very rare and valuable in providing a source of vaccine lymph. The use of a milking tube; frequent hot fomentations; and measures advised for mastitis are indicated, when the udder is inflamed.

In horse pox, clip the hair and cleanse and bathe the parts with 2 per cent. lysol solution, and apply wet compresses of the same. In later stages, the use of carbolized vaseline is to be recommended.

VERMINOUS BRONCHITIS. See *Bronchitis.*

VERTIGO. MEGRIMS. BLIND STAGGERS IN THE HORSE.

Occasionally seen in Dogs, Pigs, Cattle and Sheep.

Cover the eyes with a blanket; remove harness about the neck; and walk the animal about. Also throw cold water forcibly over the head. Cerebral congestion from pressure on the neck, or from short over-draw check, from overheating, and from chronic lung or heart disease, may cause it. Cerebral anemia or general anemia may induce the disorder. A strong glare of light affecting the eyes, foreign bodies in the ears, and perhaps indigestion, may induce megrims. Often it is an inexplicable neurosis. If cause can be discovered, it should be remedied, if possible. Animals may often be ridden without danger of an attack (which would appear if they were driven). Certain blinders favor the disorder. Regular and hard exercise is often beneficial. Following a seizure, give an aloes ball.

VESICULAR EXANTHEMA. See *Maladie du Coit.*

VILLITIS. CORONITIS (IN HORSES).

Inflammation of the coronet with heat, bulging and tenderness of the coronet; and brittle, striated appearance of hoof. If severe, separation of the hoof may occur. Remove shoes and enforce rest, with bran and flaxseed poultice to the forefeet. With the subsidence of acute symptoms, apply fly blister to the coronet. May work with bar shoes, or the animal may be sent to pasture if recovery is not rapid, but wet pastures or standing in water and snow are often responsible for the disease.

VOLVULUS OR TWIST OF THE BOWEL. See *Colic.*

Twist of the pelvic flexure of the colon in the horse is often mistaken for enteritis. Death from colic is more often death from twist. Pelvic flexure absent from proper position in left flank by rectal examination. Eserine subcutaneously is the most successful treatment.

May reduce by rectal manipulation. If this is unsuccessful, one may do a laparotomy.

WARBLES. HYPODERMOSIS (IN CATTLE, RARELY IN HORSES, AT PASTURE). Caused by Hypoderma lineata.

Prophylaxis—Prevent gadflies from lighting on cattle by the use of covers, by the application of Stockholm tar, and by spraying 3 per cent. creolin solution on the skin; also by thorough brushing to remove the eggs laid on the skin. Injection of kerosene into the openings of the swellings on the skin, by means of a machinist's oil can (when done at the earliest moment) leads to killing the larvae and subsidence of the swellings. Otherwise there is nothing to do but gently express the larvae when they are ready to escape. Incision of the swellings is undesirable.

WARTS. VERRUCAE. PAPILLOMATA.

In young animals on the belly, prepuce, mammae, lips, eyelids, ears, mouth and vagina (bitches); and about the fetlocks (grapes) in horses. They should be removed by excision with scissors, or the knife. Torsion and ligature are also employed. Strong acetic or nitric acid may be applied to small growths, but are not so certain as scissors and should never be used about the mouth or eyes. Warty growths of the lids are apt to become malignant and should be removed with a free elliptical incision;

also warts on the penis should be freely removed with scissors and their base cauterized with strong nitric acid. The actual cautery may be employed, as in grapes.

WEED. See *Lymphangitis.*

WHISTLING. See *Roaring.*

WIND GALLS.

This condition is a tenosynovitis and hygroma of the sheath of the perforatus behind the metacarpus. See *Tenosynovitis.*

WIND-SUCKING. CRIB-BITING IN HORSES.

Cover stable fixtures with metal and give so much work that vicious habits will not be acquired. The use of a muzzle or spiked strap about the larynx may sometimes prevent wind-sucking. Avoid any articles which can be bitten; feed off the ground, or remove manger after feeding. Cut hay and grain with an ounce of carron oil are indicated in tympany. Isolation of wind suckers is advisable, to avoid acquisition of the trick by other animals.

WITHERS, FISTULOUS. See *Fistula.*

WORMS. See *Parasites, Intestinal.*

WOUNDS.

Simple Operative Wounds—The hair should be shaven from the surrounding area. The simplest, and as effective as any method of skin sterilization is the application of tincture of iodine to the dry skin, or the following may be used. The skin should be washed with green soap and water, with 70 per cent. alcohol and finally with pure ether or, better, Harrington's solution. The operator's hands should be cleansed likewise and covered with rubber gloves. The wound should be handled as little as may be. All hemorrhage must be arrested. If the wound is deep, it should be closed by layers of buried catgut sutures, the skin by silk-worm gut sutures (interrupted). Drainage should be avoided unless the conditions are very unfavorable. Cover the wound with drp aseptic gauze and bandage. Secure rest by splints if possible. Leave dressings in place for a week or two, unless they become soiled and displaced.

Accidental Wounds—If the wound is fresh, arrest hemorrhage by suture; hot (or even boiling) water; ice water; actual cautery, in very vascular or deep seated parts, using a dull-red heat; rubber tourniquet; acupressure; pressure by fingers or hemostatic forceps; torsion; or chemicals—as adrenalin solution. If hemorrhage not severe or after bleeding arrested, cover wound with sterile gauze and shave or clip hair from surrounding area without the use of water. Cleanse skin with gasoline or ether. Then remove dirt from wound with sterile gauze or scissors and forceps, and also loose tissue. Swab wound and then surrounding skin with pure tincture of iodine and apply dry sterile gauze. Divided structures, as tendons, nerves and muscles, should be sutured with sterile, iodized catgut. If the surroundings are favorable and the wound can be bandaged, it should be closed as an operative wound without drainage. If the wound is deep, and the conditions unfavorable, drainage by a sterile rubber tube placed

into the deeper parts of the wound, and the rest of the wound sutured—should be the rule. It is always easy to reopen a wound and remove sutures, if infection occurs, but to secure a first intention is impossible when the wound has become generally infected. The first dressing should always be retained as long as possible to avert infection. If the wound becomes infected employ vaccines.

Bier's Hyperemia Treatment.—In human surgery no new method of treatment has proved so valuable as this within the last decade in which it has been used. Bier's treatment depends upon hyperemia produced artificially. Active hyperemia is brought about by heat, as hot air, etc. Passive hyperemia is secured by suction, as cupping and the use of other suction apparatus, and also by placing an elastic ligature about a part sufficiently tight to prevent the return of venous blood, but not so tight as to obstruct the arterial inflow. This latter method is the one which has recently been employed in veterinary surgery and is the method we will describe.

Bier finds that passive hyperemia is useful in infections and inflammations—particularly of limbs and joints—because of the following actions: 1. Bactericidal effect. 2. Relief of pain. 3. Resolution of inflammatory deposits and relief of stiffness in joints. 4. Arrest of absorption of toxins into circulation. 5. Shortening or aborting infections.

Methods of application.—A rubber Esmarch bandage, about 3 inches wide and 5 feet long, is wound about the limb of a horse tight enough to produce a warm edema below the bandage. The bandage is kept in place 20 hours out of the 24, in severe cases; or 10 hours in the 24, in milder infections. Just how tight to apply the bandage is not possible to describe. In the human, relief of pain and a red edema is the desideratum. In the horse the chief point is to avoid producing a cold limb because of too great constriction. Some animals will bite or paw and so displace the bandage. The rubber bandage should have tapes sewn on each end, and is wrapped about the limb and kept sufficiently tight by tying the two tapes together. The bandage is placed in the fore limb on the forearm above the chestnut one day, and the next below the knee (on the metacarpus), and so shifted from day to day. In the hind limb the bandage is placed one day about the middle of the tibia, and the next day below the hock. It should always be placed as far distally from the lesion as possible, but in the horse it can not be affixed at groin and axilla, as in man. The position of the bandage is shifted from day to day to avoid necrosis of the skin. It is well to protect the rubber by a cloth bandage over it. If the infection is of the knee or hock, the constriction must be above these points.

The bandage should be applied at the earliest stage of infection to secure the best results. Then edema may be expected from the bandage, but, in later stages, edema may not occur, and if this is the case the treatment is of little service. If the treatment is successful either pus will not form and resolution occur, or else it will be necessary to make but small incisions to liberate pus, and the course of the condition should be much shortened. The treatment is only applicable to cases which can be under frequent observation in order that the obstruction produced by the bandage may be regulated. Placing the finger under the bandage after its application will give one an idea of the amount of pressure, and observation of

the limb will show one if the result is obtained—edema, but warmth in the distal parts, with apparent relief of pain. The turns of the elastic bandage should spread over some area of skin and not be applied one over the other.

The appropriate conditions in veterinary practice for Bier's hyperemia include the following: Infections of the sheaths of tendons and about the feet from injuries, punctures, etc.; joint infections and stiff joints, including rheumatic joints. These embrace purulent tenosynovitis and arthritis, and phlegmons about the hoof in horses. A wet antiseptic dressing may be applied loosely over the point of infection. It is yet to be proved of how much value this method is in veterinary practice, although many favorable reports have been made. In human surgery its value is beyond cavil.

Infected and contused wounds should be treated by the application of aseptic gauze soaked in 2 per cent. creolin, covered with oil silk and bandage and renewed each day, until the septic condition has been somewhat overcome. The use of a mixed vaccine, at the outset may greatly shorten the period of healing. Unhealthy granulations are treated by applications of lunar caustic and stimulant, antiseptic remedies, as Peruvian balsam or carbolic acid in glycerin (1-10—16). A bandage should always be employed when possible. Otherwise, healing may be had under a scab by the application of tannin, silver nitrate stick, or 10 per cent. formalin; or the wound may be kept covered with an ointment of 10 per cent. boric acid in vaseline. Sometimes, if one trims off all septic tissue and disinfects the wound with tincture of iodine, or pure carbolic acid, followed by alcohol and free irrigation with 2 per cent. lysol solution, it may be possible to secure first intention by suture of an old wound. In veterinary practice, asepsis is difficult to obtain, as the application and retention of bandages, the attainment of rest of a part by position and splint, and a pure atmosphere and premises, are often unattainable. But when possible, particularly in canine practice, the methods of human surgery should be closely followed. If a fresh wound is much soiled, it may be treated with pure tincture of iodine, as above.

Perforating Wounds of the Abdomen—The surrounding region should be prepared by shaving and disinfection of the skin, as described for operative wounds. If there is protrusion of the viscera, it should be protected meanwhile by a covering of sterile gauze wrung out in hot water. If omentum prolapse, it should be ligated and excised. If there is a protrusion of bowel, it must be cleansed by the most painstaking and prolonged irrigation with warm (110 deg. F.) sterile normal salt solution (1 teaspoonful of sodium chloride to the pint of boiled water), and then returned into the belly. The abdominal wall should be closed in layers with buried sterile, chromic or tannated catgut; the skin may be approximated by interrupted silkworm gut sutures, while sutures of silkworm gut should be placed through all layers—except the peritoneum—at several points, to reinforce the catgut and prevent hernia. The wound may be sealed with iodoform and collodion (1 to 8) and covered with dry aseptic gauze held in place by adhesive plaster and bandage.

Punctured Wounds—Hemorrhage may be arrested by pressure of an aseptic tampon of gauze, after the external wound has been shaved and thoroughly disinfected with tincture of iodine. If signs of local inflammation and infection occur, then one must incise the wound down to its lowest point and drain.

Gunshot Wounds—The chief indication is to disinfect thoroughly the wound of entrance with tincture of iodine and cover with a dry, sterile, gauze dressing and bandage, and enforce rest so far as possible. Do not probe or try to remove the bullet unless it is subcutaneous. If local and general infection ensue, then incision becomes necessary to afford drainage, but not for the purpose of discovering the missile.

Joint Wounds—Here application of tincture of iodine to the wound and surrounding skin with immediate sealing of the wound with iodoform and collodion (1-8), actual cautery, or suture, and the application of splints, antiseptic dressing, and bandaging, are indicated.

See also *Ulcers, Open Joints, Bites* and *Rabies.*

The following agents are used in the treatment of wounds, and their indications may be found by consulting the index for their names. Hydrogen dioxide, lime and charcoal, alum, silver nitrate, potassium permanganate, mercuric oxides, corrosive sublimate, resin, naphthalin, chloral, chlorinated soda, chlorinated lime, iodoform, iodol, aristol, acetanilid, bismuth, salol, boric acid, sulphurous acid, nitric acid, charcoal, carbolic acid, creosote, creolin, lysol, formalin, glutol, vaseline, salicylic acid, tar, balsam of Peru, benzoin, myrrh, eucalyptol, zinc sulphate, conium, laudanum, oil of turpentine, camphor, thymol, hydrastis, tincture of aloes and myrrh, collodion, glycerite of tannin, cantharides, antiseptic poultices.

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* The accented syllable is indicated by the sign '.

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